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RIVER AND HARBOR APPROPRIATION BILL.

JANUARY 13, 1917.—Committed to the Committee of the Whole House on the state of the Union and ordered to be printed.

4.22 2.12.17
Mr. SPARKMAN, from the Committee on Rivers and Harbors, submitted the following

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REPORT.

[To accompany H. R. 20079.]

The Committee on Rivers and Harbors, having had under consideration House bill 20079, files the same and respectfully reports thereon, recommending that the bill do pass.

The bill appropriates \$38,167,339, all in cash, as there are no authorizations included, it being expected that the amounts appropriated for each item will be sufficient to carry on the various works of improvement where appropriations are for that purpose, or to continue the maintenance of projects where maintenance is contemplated, during the period from the 4th of March next to June 30, 1918, by which time it is expected another measure will have been passed making further provision for the various uncompleted projects and those requiring maintenance until the end of the next fiscal year.

The estimates submitted by the War Department for this bill amounted to \$31,123,000, \$25,200,400 of which were intended for works of improvement and partly for maintenance; \$5,572,600 for maintenance alone; and \$350,000 for examinations, surveys, and contingencies. By carefully going over these estimates in framing the bill reductions were made amounting to \$2,059,500. At the same time there were several items of increase over the estimates aggregating \$136,000, which leaves the amount for works of improvement upon old projects, for maintenance, and for examinations, surveys, and contingencies \$29,199,500. A statement showing the total of the estimates, increases, and reductions is hereto appended.

In addition to the items for work upon old projects and for the maintenance of those completed the committee included 81 new projects calling for amounts to complete aggregating \$47,050,112, though the initial appropriation for those new projects amount only

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to \$8,967,839, which, together with the items for old projects, make up the aggregate carried in the bill.

These new projects were selected from a list of 167, with amounts estimated to complete totaling upward of \$135,000,000, the most of them reported since the bill of 1913, which, with the exception of a few included in the bill of 1916, was the last to carry new projects. This, with few exceptions, has been the longest period of time without the adoption by Congress of new projects for the improvement of our waterways during the last half century. It also covers a period of great commercial growth and consequently a period during which the demands and necessity for waterway improvement have perhaps been more urgent than ever before in the history of the country.

In face of the limitation placed upon us by present Treasury conditions, coupled with the fact that a large majority of the new projects from which those in the bill were taken, are worthy, the committee experienced considerable embarrassment in making selections, but it is believed that while many worthy projects have been necessarily omitted, the most urgent have been included in the measure. The others, however, or such of them as are worthy, can be included in the next or subsequent measures, and if the policy of annual bills is continued they will all receive consideration at a comparatively early date.

It will be observed that the amount of the initial appropriations for these new projects is about one-fifth of that estimated to complete. But this does not imply that the appropriations for all of them will be made within five years of annual bills, though a large majority of them in number will be provided for somewhat short of that time, while a very few, the East River (New York) being among the number, will require a longer period, unless, as is possible, it should be found desirable to carry on the work upon these projects more rapidly than is now contemplated.

It is a matter worthy of note that the last two years of river and harbor legislation has shown a material decrease in the number of surveys ordered. While the bill of 1915, for instance, carried provisions for 209 surveys, that of 1916 only provided for 128, while this bill only contains 55 such provisions. All this would indicate that the necessities for waterway improvement are rapidly decreasing.

Attention is also directed to the provision creating a commission composed of the Secretary of War, Secretary of the Interior, Secretary of Agriculture, and the Secretary of Commerce, together with three members of the Committee on Commerce of the Senate and a like number from among those elected to the Sixty-fifth Congress and who are members of the Committee on Rivers and Harbors of the present House, to investigate the feasibility and advisability of a more comprehensive system of river and harbor improvement for the purposes of navigation, and in connection therewith the development and regulation of interstate and foreign commerce, the cooperation of railways and waterways, the promotion of terminal and transfer facilities and sites, the drainage and reclamation of lands, the irrigation of arid lands, the protection against floods, the development and utilization of water power, the clarification of streams and the regulation of the flow thereof, the prevention of soil erosion, and

the storage and conservation of waters for agricultural, industrial, municipal, and domestic uses, and to formulate and report to Congress plans for the development of the waterways and water resources of the United States for the purposes mentioned. There is and has been for some time quite an insistent demand for not only a more comprehensive system of waterway development, but in connection therewith the development and conservation of all our water resources, such as flood protection, water-power development, the conservation of waters, etc., and, in the opinion of a majority of the committee, the time has arrived when such work should be undertaken. It is therefore to be hoped that the provision will meet the approval of the House, and that the commission appointed may formulate a broad and comprehensive plan to cover the purposes mentioned, one that will meet the necessities of the country and the approval of Congress.

The committee also appends hereto such extracts from the report of the Chief of Engineers, United States Army, coupled with extracts from other reports in respect to items contained in the bill as are deemed essential to an understanding of its merits.

Estimates for continuing improvement and for maintenance for 1917-18.

Total of estimates for works of maintenance	\$5, 572, 600
Total of estimates for works of improvement and maintenance, to be carried in the river and harbor bill	25, 200, 400
Estimates for examinations, surveys, and contingencies of rivers and harbors	350, 000
Total of estimates for works of all kinds, to be carried in the river and harbor bill	31, 123, 000

ADDITIONS.

Appomattox River	\$45, 000
Vermilion River	40, 000
Channel from Aransas Pass to Corpus Christi	15, 000
Missouri River at St. Joseph	25, 000
Sacramento River	10, 000
Mokelumne River	1, 000
	136, 000
	31, 259, 000

REDUCTIONS.

Mattituck Harbor, N. Y.	5, 000
Matawan Creek, N. J.	3, 000
Alloway Creek, N. J.	3, 000
Cohansey River, N. J.	1, 000
Iron Pier in Delaware Bay	68, 000
Rockhall Harbor group, Md.	4, 800
Potomac River	23, 000
Cape Lookout, N. C.	425, 000
Sapelo Harbor, Ga.	3, 500
Alabama River	35, 000
Tombigbee River	5, 000
Louisiana waterways	3, 000
Chefuncte River group	2, 000
Vermilion River group	3, 000
Indian River, Fla.	6, 000
Atchafalaya River, La.	10, 000

RIVER AND HARBOR APPROPRIATION BILL.

Bayou Que de Tortue, La	\$3,000
Bayou Bartholomew group, La	10,000
S. W. Pass, Mississippi River	325,000
Saline River, Ark	1,500
Toledo Harbor, Ohio	10,000
White Lake Harbor, Mich	4,500
Frankfort Harbor, Mich	6,100
Charlevoix Harbor, Mich	2,100
Petoskey Harbor, Mich	5,000
Ship channel connecting waters of Great Lakes	99,000
Michigan City Harbor, Ind	8,000
Osage River, Mo	5,000
Gasconade River, Mo	5,000
Mississippi River—Ohio River to Missouri River	800,000
Columbia River above Celilo Falls	25,000
Surveys	150,000
	<u>\$2,059,500</u>
Total of the bill	<u>29,199,500</u>

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EXTRACTS FROM THE REPORT OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY, TOGETHER WITH EXTRACTS FROM
OTHER REPORTS IN RESPECT TO ITEMS CONTAINED IN THE
BILL, THE SAME BEING PART OF THE MAJORITY REPORT.

CONTINUING CONTRACTS.

The "continuing contract" provision was first introduced in the river and harbor act of 1890, applying to but five items in that act, but to increasing numbers in succeeding bills, excepting the act of 1894, which contained no such provision.

The amount yet to be appropriated for contracts authorized by previous acts is \$11,848,579.48. But, as some of the projects for which these provisions were made have been completed for less than the original estimated cost, it will not be necessary to appropriate more than \$2,500,000 of the balances unappropriated.

In the past 18 years there have been 9 general and 3 emergency river and harbor acts, making provisions as follows:

1896—Appropriations -----	\$12, 659, 550	
Contracts authorized -----	59, 616, 405	
		\$72, 275, 955
1899—Appropriations -----	15, 841, 841	
Contracts authorized -----	21, 548, 324	
		37, 390, 165
1900—Appropriation (emergency) -----		560, 000
1902—Appropriations -----	26, 771, 442	
Contracts authorized -----	38, 586, 160	
		65, 357, 602
1904—Appropriation (emergency) -----		3, 000, 000
1905—Appropriations -----	18, 181, 875	
Contracts authorized -----	17, 184, 657	
		35, 366, 532
1907—Appropriations -----	37, 108, 083	
Contracts authorized -----	49, 954, 349	
		87, 062, 432
1909—Appropriation (emergency) -----	9, 435, 750	
Contracts authorized -----	635, 875	
		10, 071, 625
1910—Appropriations -----	41, 327, 238	
Contracts authorized -----	10, 618, 605	
		51, 945, 843
1911—Appropriations -----	31, 028, 419	
Contracts authorized -----	13, 101, 645	
		44, 130, 064
1912—Appropriations -----	31, 059, 370	
Contracts authorized -----	2, 200, 000	
		33, 259, 370
1913—Appropriations -----	41, 073, 094	
Contracts authorized -----	6, 795, 800	
		47, 868, 894
1914—Appropriations -----		20, 000, 000
1915—Appropriations -----		25, 000, 000
1916—Appropriations -----	40, 598, 135	
Contracts authorized -----	2, 287, 950	
		42, 886, 085

Appropriations in all acts, for river and harbor improvements, during the years named have been as follows:

1896—River and harbor act	\$12, 659, 550	
Sundry civil act	3, 284, 597	
		\$15, 944, 147
1897—Sundry civil act	19, 121, 412	
Deficiency acts	1, 450, 000	
		20, 571, 412
1898—Sundry civil act	14, 061, 613	
Deficiency act	100, 000	
		14, 161, 613
1899—River and harbor act	15, 841, 841	
Sundry civil act	8, 918, 197	
		24, 760, 038
1900—River and harbor act	560, 000	
Sundry civil act	15, 725, 605	
		16, 285, 605
1901—Sundry civil act		7, 046, 623
1902—River and harbor act	26, 771, 442	
Sundry civil act	5, 768, 757	
		32, 540, 199
1903—Sundry civil act		20, 228, 150
1904—River and harbor act	3, 000, 000	
Sundry civil act	7, 872, 200	
		10, 872, 200
1905—River and harbor act	18, 181, 875	
Sundry civil act	10, 544, 132	
		28, 726, 007
1906—Sundry civil act		17, 254, 050
1907—River and harbor act	37, 108, 083	
Sundry civil act	6, 392, 730	
		43, 500, 813
1908—Sundry civil act		18, 092, 945
1909—River and harbor act	9, 435, 750	
Sundry civil act	19, 754, 514	
		29, 190, 264
1910—River and harbor act	41, 327, 238	
Sundry civil act	8, 051, 428	
		49, 378, 666
1911—River and harbor act	23, 855, 342	
Sundry civil act	7, 028, 077	
		30, 883, 419
1912—River and harbor act	31, 059, 370	
Sundry civil act	9, 500, 250	
		40, 559, 620
1913—River and harbor act	41, 073, 094	
Sundry civil act	10, 045, 795	
		51, 118, 889
1914—River and harbor act	20, 000, 000	
Sundry civil act	6, 998, 500	
		26, 998, 500
1915—River and harbor act	25, 000, 000	
Sundry civil act	3, 982, 000	
		28, 982, 000
1916—River and harbor act	40, 598, 135	
Sundry civil act	1, 482, 800	
		42, 080, 935

The annual expenditures for river and harbor improvements since 1895, as stated in the annual reports of the Chief of Engineers, have been as follows:

1896	\$17, 039, 731. 00	1900	\$18, 671, 340. 00
1897	13, 461, 395. 00	1901	19, 621, 227. 00
1898	17, 161, 799. 00	1902	15, 301, 148. 00
1899	15, 167, 294. 00	1903	18, 251, 217. 00

1904 -----	\$23, 843, 304. 86	1911 -----	\$32, 457, 012. 00
1905 -----	24, 648, 697. 00	1912 -----	35, 643, 918. 00
1906 -----	24, 115, 597. 00	1913 -----	40, 953, 568. 09
1907 -----	23, 092, 070. 00	1914 -----	49, 320, 425. 55
1908 -----	28, 251, 972. 00	1915 -----	43, 771, 509. 76
1909 -----	36, 753, 285. 00	1916 -----	34, 846, 496. 10
1910 -----	29, 685, 583. 00		

TENANTS HARBOR, ME.—NEW PROJECT.

Abstract from the reports of the Board of Engineers and the Chief of Engineers, printed in Rivers and Harbors Committee Document No. 12, Sixty-second Congress, third session:

Tenants Harbor, Me., is located on the west side of the entrance to Penobscot Bay, about 10 miles south of Thomaston. The village of Tenants, which has a population of about 600, is located at the head of the harbor, about 1 mile from the entrance. It is connected with Thomaston by a wagon road. The lower part of the harbor has ample depth, but it shoals as the village is approached, there being about 8 feet of water at mean low tide at the city dock. The improvement desired is an increase in depth, so as to accommodate vessels of about 15 feet draft, and for this purpose an additional depth of 8 feet or a total of 16 feet at mean low water is desired.

There is tributary to the village of Tenants a population of about 1,200, making a total permanent population of about 1,800 affected by transportation conditions in the harbor. This number of persons is increased about 1,500 during the summer. It is stated that the commerce affected amounts to about 48,000 tons, principally of cut stone, paving stone, lime, and coal. The draft of the vessels engaged in general traffic averages about 15 feet. A regular passenger steamer touches at this harbor, but having a greater depth than is available at low tide, she is scheduled to stop only when tidal conditions will permit. It appears from the communications received that it is very important that the regular steamers can enter and depart at all tides, it being claimed that general business, as well as summer traffic, would be greatly increased thereby.

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Recommendation of the Chief of Engineers:

I concur with the views of the Board of Engineers for Rivers and Harbors, and therefore, in carrying out the instructions of Congress, I report that the improvement by the United States of Tenants Harbor, Me., is deemed advisable so far as to secure an available channel depth of 15 feet and a channel width of 375 feet, at an estimated cost of \$12,500 for first construction.

No work has been done heretofore on this project.

WILLS STRAIT, CASCO BAY, ME.—NEW PROJECT.

The following report of the Board of Engineers, in which the Chief of Engineers concurs, is printed in House Document No. 1416, Sixty-second Congress, third session:

Wills Strait is a narrow, obstructed passageway between the waters of Harpswell Sound on the west and Casco Bay on the east, about 14 miles a little north of east of Portland, Me. Were it not for this strait, vessels would have to go outside of Jaquish Island, 3 miles to the southward, where the route is exposed to the open sea. On account of the protection offered, the cut through the strait is of great value and importance to light-draft navigation. Many small vessels, estimated during the summer season at 100 per day, engaged in fishing, freighting, and in the pursuit of pleasure, pass through this strait. The amount of commerce handled has not been definitely determined, but the district officer states that the improvement desired, which is a straighter and deeper channel through the dangerous and obstructed waterway, would be of great value to navigation and would probably tend to the preservation of both life and property.

Based upon the survey just made and a further study of conditions obtaining at this locality, the district officer concludes that a channel depth of 8 feet at

mean low water and width of 70 feet at the eastern passage, full width of 40 feet through the drawbridge, with the approach on the southerly side of the draw widened so as to make the entrance easier, is essential for the convenient and safe handling of vessels through this passageway. The estimated cost of the work proposed is \$16,500, and it is stated that it is practically certain that there will be no cost for maintenance. The district officer and the division engineer recommend the improvement in accordance with the project just outlined.

While the freight tonnage passing through this waterway is probably not very large, a great many vessels utilize it, and the improvement, which would be largely the removal of submerged rock obstructions, would lend an element of safety and confidence to navigation at this locality, and it is believed that the cost involved, considering that there will probably be no charge for maintenance, is reasonable. The board therefore concurs with the district officer and the division engineer and reports that, in its opinion, it is advisable for the United States to undertake the improvement outlined by the district officer, at an estimated cost of \$16,500.

No work has been done heretofore on this project.

NARROWS OF LAKE CHAMPLAIN, N. Y. AND VT.

Location and description.—The Narrows of Lake Champlain is that portion of the lake at its southern end, 37 miles long, located between Whitehall and Crown Point, N. Y. The portion under improvement is that extending from Whitehall, N. Y., at the southern extremity of the lake, northerly to Benson Landing, Vt., a distance of 15 miles. Burlington Harbor, Vt., is 80 miles by water north of Whitehall, and New York City is 214 miles south by water via the Champlain Canal and the Hudson River.

Condition at the end of fiscal year.—The project has been completed. Dredging, completed in 1904, and a small amount of rock excavation, completed in 1888, resulted in the creation of a channel 12 feet deep at low lake level from 100 to 200 feet wide through the reach under improvement. Fender-boom protection was also provided along three rocky points by operations completed in 1906. On June 30, 1916, the maximum draft that could be carried over the shoalest part of the section under improvement was about 9 feet, low lake level. The total expenditure for improvement under the project was \$24,000, and for maintenance \$13,015.17, a total of \$37,015.17.

Effect of improvement.—This waterway is a link in the great international waterway between Montreal and New York, which was formerly the controlling factor in fixing freight rates in this locality. Its influence is still strong, though it has declined recently owing to the deterioration of the Champlain Canal, but is expected to be revived on the approaching completion of the New York State barge canal system, with its facilities for larger and more modern boats.

The additional funds requested are to cover dredging which may be found necessary at other points in order to accommodate this new type of traffic, which the ore interests along Lake Champlain are very desirous to inaugurate. The following estimate is submitted:

Maintenance, dredging 22,500 cubic yards, at 20 cents per cubic yard---	\$4, 500
Engineering and contingencies-----	500
Total-----	5, 000

Commercial statistics.—The commerce within the limits of the improvement, mainly in general merchandise, coal, lumber, iron ore,

wood pulp, pulp wood, and building material, is carried by fleets of canal boats of about 5 feet draft towed by tugs of a maximum draft of about 12 feet. As obtained from transportation companies and reports of clearances on the Champlain Canal, the tonnage and value of this commerce are as follows:

Comparative statement.

Year.	Short tons.	Value.
1913.....	424,933	\$4,675,311
1914.....	466,700	4,448,438
1915.....	437,791	5,425,524

There are no lines engaged in the regular transportation of passengers, but occasional excursions on large steamers come to Whitehall, and there is a considerable motor-boat traffic.

The original project was adopted in 1886.

Amount expended on all projects from 1886 to June 30, 1916:	
New work.....	\$82,000.00
Maintenance.....	18,515.17
Total	100,515.17
July 1, 1916, balance available.....	6,857.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	
	5,000.00

NARROWS OF LAKE CHAMPLAIN, N. Y. AND VT.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1387, Sixty-second Congress, third session:

The present project for the improvement of the Narrows of Lake Champlain, adopted in 1899, provides for the widening of the channel and restoration of the depth to 12 feet at low water, and the placing of fenders at certain points to protect barges from collision with the rocky banks of the channel. This project was completed in 1905, and subsequent expenditures have been applied to maintenance. To adapt this channel to the boats which will use it upon completion of the enlarged Champlain Canal and communicating waterways the district officer submits, with favorable recommendation, a project providing for a channel 12 feet deep and 200 feet wide, except at one point through rock, where the width is reduced to 150 feet. The estimated cost of this plan, including the placing of new fender booms, is \$737,000, and \$5,000 annually for maintenance.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to the board's report of February 6, 1913, concurring generally with the views of the district officer. The board is not satisfied that the cut-offs at Maple Bend and Chilton Bend may not be omitted without serious inconvenience to navigation and with a very material reduction in cost. If the improvement be adopted by Congress, further study of this part of the channel should be made before the work is undertaken.

I concur in general with the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore in carrying out the instructions of Congress I report as follows: That the improvement by the United States of the Narrows of Lake Champlain, N. Y. and Vt., is deemed advisable so far as to secure an available channel depth of 12 feet with a general width of 200 feet on the bottom, at an estimated cost of \$737,000 for first construction and \$5,000 annually for maintenance.

BEVERLY HARBOR, MASS.—NEW PROJECT.

[Abstract from the reports of the Chief of Engineers and the Board of Engineers, printed in House Document 220, Sixty-third Congress, first session, and Rivers and Harbors Committee Document 8, Sixty-third Congress, second session.]

Beverly Harbor lies at the western end of Salem Bay, Mass. It is formed by the confluence of three tidal inlets and is a basin of irregular shape about three-eighths of a mile in diameter, with flats and shoals on the west, south, and east sides. It is crossed at its extreme western extremity by two draw-bridges, Essex Highway Bridge and Boston & Maine Railroad Bridge.

The present project for the improvement of Beverly Harbor provides for a channel 250 feet wide and 18 feet deep for 3,200 feet in the approach channel between Bar Beacon and Lobster Rocks Beacon, and not less than 200 feet wide for the next 2,000 feet up to the lower end of the draw pier of the highway bridge. It appears that this depth is not sufficient for easy navigation by vessels of the size now regularly using the port. The district officer submits a plan providing for a channel 24 feet deep at low water, 200 feet wide in straight reaches, with appropriate increased width at the bends, the cost of which by way of the northerly route shown on accompanying map is estimated at \$173,000.

The Chief of Engineers says: "After due consideration of the above-mentioned reports, I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors; and, therefore, in carrying out the instructions of Congress, I report as follows: That the improvement by the United States of Beverly Harbor, Mass., with a view to securing a channel depth of 24 feet and of widening the channel on the northern side by the removal of the ledge near the Essex Bridge, is deemed advisable so far as to secure an available channel depth of 24 feet and a channel width of 200 feet, increased at entrances and on curves, by way of the northerly route shown on accompanying map, at an estimated cost of \$173,000 for first construction, provided suitable bulkheading inclosing a sufficient area at and to the eastward of Tucks Point be furnished by the State or municipalities to afford a dumping place for about one-third of the dredged spoil, said bulkhead to extend from the foot of Maple Avenue about 1,100 feet parallel to and about 75 feet inside of the northern limit of the proposed new channel, as shown on the map accompanying survey report; that the United States be permitted to dump behind said bulkhead such material as can be economically excavated with a pump dredge; that dredged spoil which can not economically be pumped ashore directly by the United States shall be dumped at sea by the United States or rehandled ashore behind such bulkhead at the expense of the State or city, at their option; that the United States shall have the right to determine the methods of excavation to be adopted; that all land formed by the deposit of spoil behind the bulkhead shall be pledged by the State or municipality as a permanent site for public wharves open to all water carriers on equal terms; and that prior to the initiation of Federal work a cash deposit of \$50,000 be made to the credit of the Secretary of War, to be applied to dredging the 24-foot channel along the northern route. The full share of the cost of the improvement to be borne by the United States, \$123,000, should be provided in one appropriation, the improved channel to be maintained by the State or municipality. The removal of the ledge near the Essex Bridge, in the manner apparently desired by the interests concerned, is not deemed advisable at the present time."

Freight traffic, 1911.

Articles.	Customary units.	Short tons.	Valuation.
Coal.....	157,539 short tons.....	157,539	\$583,422.04
Iron.....	112 short tons.....	112	3,000.00
Lumber.....	5,302,266 feet.....	8,063	132,054.88
Oil.....	{316,284 gallons.....	1,265	8,697.81
	{548,823 barrels.....	76,399	694,426.00
Lime.....	800 barrels.....	86	800.00
Sand.....	390 short tons.....	390	450.00
Asphalt.....	3,300 barrels.....	719	11,504.00
Machinery, etc.....	50 short tons.....	50	30,000.00
Total.....	.....	¹ 244,623	¹ 1,464,354.73

¹ Incomplete.

The original project was adopted in 1902.

Amount expended on all projects from June 13, 1902, to June 30, 1916:

New work-----	\$48, 604. 59
Maintenance -----	392, 65
Total-----	48, 997. 24

BOSTON HARBOR, MASS.—NEW PROJECT.

The following report of the Board of Engineers, in which the Chief of Engineers concurs, is printed in House Document 931, Sixty-third Congress, second session:

1. The act of July 25, 1912, provides for a preliminary examination of Boston Harbor, Mass., with a view to securing increased width and depth in the channel from President Roads to the sea; also with a view to providing deep-water connection with such suitable terminals as may be established by the directors of the port of Boston. The act of March 4, 1913, provides for an examination of Boston Harbor, Mass., with a view to securing increased width and depth of channel from Mystic River to President Roads. Both subjects are covered by the reports on preliminary examination and survey, submitted herewith, under the act of 1912.

2. The entrance channels to President Roads have been under improvement since 1867 under projects providing successively for depths of 23, 27, 30, and 35 feet. On these channels there had been expended to June 30, 1912, practically \$11,000,000. The total expenditures for the harbor, including tributary streams and auxiliary works, have amounted to something over \$12,000,000. The 23, 27, and 30 foot channels have been completed. The 35-foot project, which provides for a width of 1,500 feet in Broad Sound and 1,200 feet inside of President Roads, was adopted by the act of June 13, 1902, and is nearly complete, there being an available depth of 33 feet, although the work done has not included the removal of Finns Ledge, a detached 25½-foot ledge lying about a mile outside of but in line with the 35-foot channel. The district officer states that if a 40-foot channel is provided by Congress, the best method of disposing of Finns Ledge will be to use it as a foundation for a lighthouse. The range of tides at Boston Navy Yard is from 8.1 feet to 10.9 feet, the mean tide being 9.6 feet.

3. The foreign commerce reported herein has in recent years ranged from about 1,600,000 to 2,000,000 tons, valued at \$190,000,000 to \$200,000,000. There is also very large coastwise commerce at Boston, but this is carried in moderate draft vessels and does not properly enter into the consideration of greater depths in the channels of approach to this harbor. Several large foreign steamship lines have recently entered the Boston service, and the further improvement of the entrance channels desired is largely to meet this condition.

4. The State of Massachusetts, through the directors of the port of Boston, is doing its part toward the development of the harbor by the creation of an anchorage basin, connecting channels, and extensive terminals, on which and for other improvements there has been expended nearly \$8,000,000 up to the present time, and provision has been made for a further expenditure of about \$7,000,000. It is in connection with the latter that the second item of the act is concerned.

5. The district officer's study of the needs of commerce in the inner harbor, taking into account the low tides at certain times, the effect of the winds upon the water surface, the presence of ledge rock on the bottom, and the necessity of ample clearance for deep-draft vessels, has led him to the conclusion that a depth of 40 feet at mean low water is essential. He has given consideration to a width of 1,200 feet, corresponding to that of the present channel, but concludes that a width of 600 feet will answer the needs of the port for many years to come. The survey covered a channel north of Governors Island, as suggested by the directors of the port of Boston, but the results show that to create a channel here 40 feet deep would be much more expensive than by following the present channel. Moreover, it appears that the proposed terminal developments at East Boston will not be available in the near future, and therefore the channel to the north of Governors Island is not urgently needed.

6. Various estimates are submitted for the outer or Broad Sound Channel covering widths of from 900 to 2,000 feet by slightly different routs and depths

of 40 and 45 feet. The investigations of the district officer, which included consultations with experienced navigators, led him to the conclusion that a channel depth of 45 feet in the rock section and a nominal depth of 40 feet elsewhere, with a width of 900 feet, widened to 1,100 feet at the outer end where the channel bends to the eastward of Finns Ledge, will serve the needs of commerce for the present. From the prompt and economical execution of the project and its subsequent maintenance, the district officer believes a seagoing ladder dredge, with necessary floating plant, is desirable, and he submits an estimate therefor. He recommends the locality as worthy of additional improvement in accordance with the following estimates:

An inner channel 600 feet wide, 40 feet deep, from President Roads to the navy yard-----	\$2, 300, 000
An outer channel from President Roads to the sea, 900 feet wide, with a slight bend at the outer end, and 1,100 feet wide at the entrance east of Finns Ledge, 45 feet deep, through rock, and of sufficient depth to insure safe navigation at mean low water for vessels requiring 40 feet draft in the inner harbor-----	985, 000
Dredge with seagoing tug and dump scows-----	560, 000
Total-----	3. 845, 000

His estimate for the maintenance of the project is \$30,000 per annum. The division engineer concurs in the views and recommendations of the district officer.

7. In addition to the information secured through the reports on preliminary examination and survey, the board held a public hearing in reference to this subject in the city of Boston, on March 19, 1913, which was largely attended by representatives of the principal interests concerned. It appears that the needs of the city of Boston have up to the present time outgrown successively the various projects adopted for the entrance channels, and arrangements have recently been made with some of the more important transatlantic lines to engage in service at this port, using large and deep-draft vessels, for which an increase in depth is considered necessary. It is claimed that out of a total of 172 vessels in existence in 1911-12 having a length of 500 feet or over 25 were in the Boston trade, and four others over 600 feet in length had been contracted for. These vessels draw from about 30 feet up to 34 feet. Stress was laid upon the fact that Boston has an advantage over New York in that it shortens the trip to European ports by 190 miles, a matter of particular importance to the passenger service.

8. It is quite clear from the data presented that the present entrance channels at Boston Harbor have ample width, and that the additional depth desired is merely to enable a few large transatlantic passenger boats to sail fully loaded without reference to the tide. The European ports for these same boats do not generally have as great low-water depth as that already provided at Boston. A change of not exceeding three hours from a fixed time of departure would apparently enable the largest of these boats to sail without any difficulty. It is not believed that the resulting inconvenience would be sufficient to warrant the large initial expenditure of nearly \$4,000,000 to prevent it.

9. On the other hand, it is apparent that, on account of the exceptional exposure of this locality, a somewhat greater depth is necessary in the outer channel from President Roads to the sea in order to give it a capacity equivalent to that of the inner channel, and the board believes that a depth of 40 feet is required for this purpose. Moreover, in giving the depth of 40 feet it is considered advisable to remove ledge rock to a depth of 45 feet, as the additional expense involved is not very large. The board therefore concurs with the district officer and the division engineer in recommending the outer channel proposed by the district officer, except that the general project depth should be limited to 40 feet. The board also concurs with the district officer and the division engineer in the opinion that it is of great importance to provide the Government dredge.

10. In conclusion, therefore, the board considers it inadvisable to enlarge the present inner channels of Boston Harbor at this time, but it is of opinion that the general project for the harbor should be modified by providing a channel between President Roads and the sea, on the lines recommended by the district officer, 900 feet wide except at the outer end, where it is widened to 1,100 feet, 40 feet deep in general, but 45 feet deep through rock, and the

building of a dredging plant, at a total estimated cost of \$1,545,000. The initial appropriation should provide the sum of \$400,000 in cash and contract authorization for the balance.

11. The board concurs with the district officer and the division engineer in the opinion that a lighthouse on Finns Ledge is essential to properly mark the entrance and give reasonable safety to navigation.

Amount expended on all projects from 1827 to June 30, 1916:

New work-----	\$11, 755, 543. 83
Maintenance-----	514, 452. 36
Total-----	12, 269, 996. 19

POLLOCK RIP SHOALS, NANTUCKET SOUND, MASS.

Location and description.—Pollock Rip Channel is the northerly passage through the shoals off the eastern entrance to Nantucket Sound, connecting the deep water of the sound with that of the ocean. It is about 26 miles east from the harbor of Vineyard Haven on the island of Marthas Vineyard, Mass., and 60 miles south from Provincetown Harbor, at the northern extremity of Cape Cod.

Existing project.—The present project provides for experimental dredging through the shoals at eastern entrance to Nantucket Sound, using an available Government-owned plant, under appropriations aggregating \$250,000 with a view to determining the amount of improvement, if any, which may be advisable. This project was adopted by the river and harbor act of July 25, 1912, following a report published in House Document No. 536, Sixty-second Congress, second session. This project was extended by the river and harbor act of July 27, 1916, following a report on the results accomplished by the experimental dredging published in House Document No. 3, Sixty-fourth Congress, first session, which provided for the temporary transfer of a Government-owned dredge to the work and an appropriation of \$150,000 for its operation for one year. The general duties of the dredge are to keep constantly in touch with the location of the best channels and to assist, by dredging, the natural agencies wherein their tendencies are favorable to improvements in the location and depth of the navigable channel. No specific width and depth of channel have been provided for. The mean range of the tide is about 3.7 feet at Monomoy Point.

Condition at the end of fiscal year.—The result up to the close of the fiscal year has been a net gain of about 700 feet in channel width of 30 feet depth, and a clear, straight passage about 2,500 feet long, with a minimum depth of 21 feet through the shoal at the northeasterly end of the channel. The permanence of this is yet to be demonstrated, but it has been demonstrated that a dredge of the type used is well adapted to the conditions that obtain in the locality and to the material to be handled. In the vicinity of Stone Horse Shoal the increased width of channel at a point where there is a sharp bend in the existing sailing course has been immediately beneficial to navigation. The Shovelful Light Vessel, marking the turning point in this part of the channel, has been moved about 3,000 feet to the south and renamed the Stone Horse Light Vessel. The increased depth obtained at the eastern end of the channel has not been utilized by commercial vessels, but is expected to be of great importance in connection with the further prosecution of this work.

The total expenditures under the present project have been \$250,358.26, all of which were for original work.

Effect of improvement.—The effect of the improvement on freight rates, if any, will not be known until the improvement is completed, but the widening of the channel near the Shovelful Light Vessel has made the sharp turn in the sailing course somewhat easier.

Proposed operations.—With the funds available, the U. S. dredge *Navesink*, transferred to this work, will be stationed on the work, as far as the weather conditions will permit, during the year, dredging at points where observation may indicate that the tendency of the natural forces are favorable to improvement in the location and depth of the navigable channels, having in mind the special features desired by the commercial interests. The funds will be expended for the operation, upkeep, and repairs required for the dredge working in such an exposed locality and will be exhausted about August, 1917.

It is proposed to continue the same work, modified as experience may indicate, with the funds asked for in the estimate submitted, which comprises the cost of operation and maintenance for one year of the seagoing dredge *Navesink* at \$150,000, the appropriation of which is necessary to carry out the purpose of the improvement.

Commercial statistics.—It is estimated that a commerce of over 20,000,000 short tons annually will be benefited greatly if it be practicable to construct and maintain the proposed channel. It is impracticable to estimate the value of the commerce passing through this locality. During the calendar year 1915 the following vessels are reported as having passed the Pollock Rip Slue Light Vessel: Steamers, 6,023; sailing, 3,325; barges, 7,805.

Amount expended on all projects, from July 25, 1912, to June 30, 1916—new work	\$250,358.26
Balance available for fiscal year ending June 30, 1917	150,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement and for maintenance	150,000.00

HARBOR OF REFUGE AT NANTUCKET, MASS.

Location and description.—The harbor of Nantucket is an indentation in the coast line on the northerly side of the island of Nantucket.

Existing project.—The present project provides for securing a depth over the bar at the entrance of 15 feet at mean low water by means of converging jetties and by dredging at an estimated cost of \$475,000. The mean range of the tide is 3 feet.

Condition at the end of fiscal year.—At the close of the fiscal year about 95 per cent of the existing project was completed, the result of which is a channel 300 feet wide and 15 feet deep at mean low water from the deep water in Nantucket Sound to the deep water in Nantucket Harbor, a distance of 1.4 miles, with an additional width of 150 feet, over the greater part of which there is a 12-foot depth, except that near the end of the jetties and beyond them there is a tendency to shoal. The total expenditure under the existing project was \$523,202.99, of which \$426,595.70 was for new work and \$96,607.29 for maintenance.

Effect of improvement.—So far as known the project has had no effect on freight rates, but the widening and deepening of the channel gives the use of the harbor to vessels of larger size.

Proposed operations.—It is proposed to apply the funds at present available to repairing the outer portion of the east jetty where it has been damaged by storm and ice to rebuilding the mound at the outer end. Experience has shown that stone can be economically placed at this place at the rate of about 1,800 tons per month, costing about \$3,600. With the funds appropriated by the river and harbor act of July 27, 1916, it is proposed to extend the west jetty as far as these available funds will permit, using them at the same rate.

With the funds asked for it is proposed to complete the extension of the west jetty to a point opposite the outer end of the east jetty, repair both the east and west jetties, and fill in the gap in the east jetty near the shore at a cost of \$30,000 with a view to reducing the amount of sand entering the channel through the jetties and thereby diminishing the tendency to shoal on the outer bar, and to maintain by dredging the depth in the entrance channel which has deteriorated, at a cost of \$15,000.

The appropriation of these amounts is necessary in order to carry out the purpose of the improvement.

Commercial statistics.—The commerce consists of fish, coal, lumber and other building materials, and general merchandise.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	35,000	\$1,200,000
1914.....	36,353	1,488,381
1915.....	45,836	1,968,137

Amount expended on all projects from March 2, 1829, to June 30, 1916:

New work.....	\$472,430.45
Maintenance.....	96,607.29
Total.....	569,037.74
Balance available for fiscal year ending June 30, 1917.....	17,435.76
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	45,000.00

MYSTIC RIVER, MASS.

Location and description.—This river rises in Mystic Lakes, Mass., and after flowing about 7 miles in a southeasterly direction, empties into Boston Harbor near the Charlestown Navy Yard. Its improvement is embraced in two sections. The one included under this subheading extends from the Boston & Maine Railroad bridge (western division) to the head of commercial navigation at Cradock Bridge, Medford, 3 miles, or about 5 miles above the mouth, this also being the upper limit of tidal influence.

Existing project.—The existing project covers a length of 3 miles, commencing about 2 miles above the mouth of the river, and provides for obtaining a channel 100 feet wide and 6 feet deep at mean low water from the Boston & Maine Railroad (western division)

bridge up about 1 mile to the first turn above Dennings Wharf, about 2,500 feet above Wellington Bridge, and thence 2 miles to the head of navigation at Cradock Bridge in Medford, 4 feet-deep at mean low water, gradually narrowing from 100 feet to 50 feet at the upper end, at an estimated cost of \$25,000. (Annual Report for 1891, p. 672, where also will be found the latest published map.) No estimate of cost of maintenance was stated. The project was adopted by the river and harbor act of July 13, 1892. The mean tidal variation is 9.8 feet.

Condition at the end of fiscal year.—By dredging, a channel of the projected dimensions was completed in November, 1906. A survey in May and June, 1916, shows that the portion of the channel normally 6 feet deep now has an available navigable depth of but about $4\frac{1}{2}$ feet at mean low water and that while the portion of the channel normally 4 feet deep has that depth throughout its length, the width is contracted by caving of the banks. The expenditures were \$28,794.88 for new work and \$250 for maintenance, a total of \$29,044.88. At Cradock Bridge, Medford, 5 miles above the mouth of the river, is a dam built and maintained by the Commonwealth of Massachusetts. The river at this point is 110 feet in width. The dam includes a boat lock 60 feet in length, canoe rollway, weirs which ordinarily will automatically regulate the height of the water above the dam, and sluice gates operated by electric motors, for use when needed. The dam is intended to completely exclude tidewater and maintain the level of the river above the dam at a grade about 3 feet below mean high water and with a navigable depth varying from 7 feet at the dam to 4 feet at the Lower Mystic Lake. Data concerning lock:

Dimensions: 15 feet wide, 45 feet long.

Lift: 6.3 feet above mean low water.

Completed: 1909.

Cost: Unknown.

Effect of improvement.—It is reported that barges of the lightest draft remaining in service deliver coal at Medford without the expense of lightering, which would be about 50 cents per ton.

Proposed operations.—No funds are available. A recent survey shows that the channel has deteriorated and requires redredging almost throughout its entire length, for which the following estimate is submitted for the year ending June 30, 1918:

73,040 cubic yards (scow measurement), allowing for 1.5 feet over-	
depth at 30 cents per cubic yard-----	\$21, 900
Engineering and contingencies, 10 per cent, say-----	2, 100
	<hr/> 24, 000

Commercial statistics.—The commerce during the current year consisted chiefly of coal.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	24,328	\$172,611.10
1914.....	29,487	188,700.00
1915.....	27,682	178,466.62

Amount expended on all projects from July 13, 1892, to June 30, 1916:

New work-----	\$28,794.88
Maintenance-----	250.00
Total-----	29,044.88
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	24,000.00

PAWCATUCK RIVER, R. I. AND CONN.

Location and description.—Formed by the junction of the Wood and Charles Rivers in southwestern Rhode Island, the river flows westerly and southerly 18 miles and enters Little Narragansett Bay about 13 miles east of New London Harbor.

Existing project.—The project provides for a channel 10 feet deep from Stonington, Conn., to Westerly, R. I., 200 feet wide from Stonington to Avondale, R. I., about 4 miles; 100 feet wide from Avondale to the lower wharves at Westerly, about 3 miles; 40 feet wide between the upper and lower wharves of Westerly, about one-half mile; and the removal of obstructions at Watch Hill, at the southeastern part of Little Narragansett Bay.

Condition at the end of fiscal year.—The channels have been dredged to project dimensions, except that the channel in the bay has a general width of 100 feet and the channel in the river at Pawcatuck Rocks has a width of 80 feet. The most obstructive bowlders in the vicinity of Watch Hill have been removed, the work being completed in 1913. The project is 74 per cent completed. The controlling depths are 9 feet to Westerly and 6 feet to Watch Hill. The work required to complete the project is the widening of the channel to 200 feet to Avondale, and the removal of rock at Pawcatuck Rocks. The expenditure under the existing project to the end of fiscal year is, for new work, \$83,160.89; for maintenance, \$16,452.13; total, \$99,613.02. The proportionate cost of the completed improvement is 54.4 per cent less than the original estimate, the saving amounting to \$67,566.24.

Local cooperation.—No conditions for local cooperation were prescribed by law at the time of the adoption of the project. Obstructive bowlders have been removed from the bay at Watch Hill by the Watch Hill Improvement Association at a cost of \$1,025.

Effect of improvement.—The improvement affords the town of Westerly the benefit of water transportation, which could not be carried on under modern conditions in the river in its natural state. The improvement has resulted in a reduction of the rates on bulk commodities.

Proposed operations.—It is proposed to apply the available funds, including those appropriated by the river and harbor act approved July 27, 1916, to maintenance dredging in Little Narragansett Bay and at Westerly during the fiscal year ending June 30, 1917, as follows:

Dredging 6,000 cubic yards, at 30 cents-----	\$1,800
Administration and inspection-----	211
Total-----	2,011

It is proposed to apply the funds for which estimate is submitted to dredging in Little Narragansett Bay and at Westerly. While the amount of material that must be removed can not be predicted with certainty, the estimate is based on the following itemization:

Dredging 2,300 cubic yards, at 30 cents.....	\$690
Administration, inspection, and contingencies.....	310
Total.....	1,000

Channels of the present dimensions, see above, will conveniently accommodate present and reasonably prospective commerce. It is accordingly not proposed at the present time to prosecute the project toward completion, and the estimate submitted is for maintenance only of the channel dimensions previously obtained.

Commercial statistics.—The principal items of freight for the calendar year were coal, lumber, and paving blocks, carried principally in canal boats and box barges, drawing from 7 to 10 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	56,400	\$351,509.01
1914.....	47,506	331,949.25
1915.....	39,073	494,752.69

Amount expended on all projects from Mar. 3, 1871, to June 30, 1916:

New work.....	\$180,660.90
Maintenance.....	16,452.13
Total.....	197,113.03

Amount (estimated) required to be appropriated for completion of existing project.....	66,572.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	1,000.00

PAWTUCKET RIVER, R. I. AND CONN.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1283, Sixty-fourth Congress, first session:

The existing project, adopted by the act of March 3, 1905, provides for a channel from Providence Harbor to Pawtucket, a distance of about 3.4 miles, 16 feet deep at mean low water and 100 feet wide, the width being reduced to 50 feet through the rock ledge at Pawtucket. The total estimated cost of the work was \$237,875, of which the State of Rhode Island has contributed \$67,792. The act of March 3, 1909, authorized the expenditure of any balance remaining after the completion of the project in deepening the channel to 18 feet and increasing the width at such places as would best subserve the interests of commerce. Under this provision a small portion of the rock work between the wharves at Pawtucket was deepened to 18 feet, and the channel was widened to 230 feet at the bend at Phillipsdale. Owing to the amount of rock in the upper part of the channel, the district officer states that it is not practicable to provide increased depth at reasonable cost, and he believes that the present project depth of 16 feet should be retained. As practically all vessel movement on the river is by towing, except in the case of a few steamers, very decided advantage would be secured by widening the channel to facilitate the passing of tows. He

submits with favorable recommendation an estimate of the cost of widening the 16-foot channel from 100 feet to 150 feet, without increasing the width through the ledge between the wharves, amounting to \$61,440. The division engineer believes that the proposed modification of the project is desirable, but recommends that no action be taken under the general authority contained in section 14 of the river and harbor act approved March 4, 1915.

I concur in the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore report that it is deemed advisable to modify the existing project for improvement of Pawtucket River, R. I., by increasing the width of the channel from 100 feet to 150 feet, except through the ledge at Pawtucket, at an estimated cost of \$61,440.

NEW LONDON HARBOR, CONN.

Location and description.—On the north shore of Long Island Sound, at its eastern end, and about 14 miles east of the mouth of the Connecticut River. The harbor comprises the lower 3 miles of the Thames River, is from about one-fourth to $1\frac{1}{4}$ miles wide, and includes Shaws and Winthrops Coves, both lying on the westerly side near its head.

Existing project.—The project as modified and extended provides for an entrance channel 600 feet wide, 33 feet deep, and about $3\frac{1}{2}$ miles long from Long Island Sound to the natural deep water in the upper harbor; a channel 400 feet or more in width, 23 feet deep, and about 6,000 feet long skirting the water front of the city; and for dredging Shaws Cove to a depth of 15 feet. The plane of reference is mean low water, the mean tidal range being 2.6 feet. The estimated cost of the improvement is, for new work \$487,000 and for maintenance \$3,300 per annum.

Condition at the end of fiscal year.—The channels along the water front and in Shaws Cove were completed in 1913. No dredging has been done in the entrance channel. The controlling depths at mean low water are: Entrance channel, 26 feet; channel along the water front, 22 feet; Shaws Cove, 14.7 feet. The expenditures under the existing project to the end of the fiscal year are: For new work, \$152,330.55; for maintenance, \$1,881.94; total, \$154,212.49.

Local cooperation.—The river and harbor act of July 27, 1916, adopted the project for an entrance channel in accordance with report in House Document No. 613, Sixty-third Congress, second session, subject to the condition named in that document that work be begun only after assurance satisfactory to the Secretary of War has been given that the State will carry out its project of terminal development practically as described in the report. The terminal development thus described includes the construction of a pier with modern cargo-handling facilities, warehouse storage, railroad connections, and suitable approach channels, at an estimated cost of \$1,000,000. The pier has been completed, approaches thereto from the main channel dredged, and contract entered into for the construction of the superstructure and the installation of unloading facilities. It is expected by the State authorities in charge of the construction that the work will be fully completed by January 1, 1917.

Effect of improvement.—The effect of the improvement has been to materially reduce freight rates.

Proposed operations.—With the available funds, appropriated by the river and harbor act approved July 27, 1916, it is proposed to dredge the entrance channel throughout its length to project depth and about half project width. It is expected that this work will be begun early in October, 1916, by Government plant, and that the available funds will be exhausted in one year, as shown by the following estimate:

Operation of seagoing hopper dredge for 12 months, at \$9,000 per month	\$108,000
Rental of above dredge for 12 months, at \$3,700	44,400
Administration, superintendence, and contingencies	17,600
Total	170,000

The following estimate for the completion of this project during the fiscal year ending June 30, 1918, is submitted:

1,200,000 cubic yards dredging, at 12 cents	\$144,000
Administration, superintendence, and contingencies	16,000
Total	160,000

Commercial statistics.—The principal items of freight for the calendar year were general merchandise, coal, and lumber, carried principally in steamers, barges, and schooners drawing from 12 to 22 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	924,127	\$112,332,489.00
1914.....	824,095	102,871,515.53
1915.....	786,551	117,779,117.02

Amount expended on all projects from June 14, 1880, to June 30,

1916:

New work	\$172,130.55
Maintenance	1,881.94

Total	174,012.49
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Balance available for fiscal year ending June 30, 1917	171,161.18
Amount (estimated) required to be appropriated for completion of existing project	160,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement	160,000.00

NEW HAVEN HARBOR, CONN.

Location and description.—On the north shore of Long Island Sound, about 71 miles to the east of New York City. The harbor consists of a bay about 4 miles long and from 1 to 4 miles wide, and the navigable portions of West River, entering the westerly side of the bay, and the Mill and Quinnipiac Rivers entering its northeast corner through a common mouth.

Existing project.—The project now provides for a channel 20 feet deep, 400 feet wide, and 3 miles long, from Long Island Sound to the inner end of the 20-foot anchorage basin; thence of same depth,

700 to 500 feet wide (increased to 1,200 feet at the turn opposite Long Wharf), 1.2 miles to Tomlinsons Bridge; three anchorage basins below Tomlinsons Bridge of 20, 16, and 15 foot depths; a channel 100 feet wide and 12 feet deep from the 15-foot anchorage basin toward Brewery Street, about 1,500 feet; a dike to contract the tidal flow at Fort Hale Bar; a channel 200 feet wide and 12 feet deep up the Quinnipiac River to Ferry Street and 50 to 100 feet wide and 8 feet deep between Ferry Street and Grand Avenue; a channel up Mill River 200 feet wide and 12 feet deep to the junction of the two branches above Chapel Street, and thence channels 12 feet deep extending to Grand Avenue, with width in the east branch of 100 feet and a general width in the west branch of 125 feet; a channel 12 feet deep and 100 feet wide, from the southwest corner of the 16-foot anchorage basin via Oyster Point and the dock frontage of West Haven to Kimberly Avenue Bridge; thence 12 feet deep and prevailing width of 75 feet up West River approximately to the railroad bridge; an anchorage basin 6 feet deep in West River opposite Mars Dock; and the removal of certain obstructive rocks in Morris Cove.

All depths refer to mean low water, the mean tidal range being 6 feet. The estimated cost of the improvement, exclusive of the expenditures reported in the preceding paragraph, is \$722,700 for new work. Estimates for maintenance are not included in several of the component plans, but this estimate is now placed at \$10,000 per annum. For map, see House Document No. 497, Sixty-fourth Congress, first session.

Condition at the end of fiscal year.—A dike had been constructed at Fort Hale bar. All channels and anchorage basins had been dredged to prescribed dimensions and the existing project completed in 1915. The controlling depths at mean low water are: Main channel, 20 feet; anchorage basins, 12½, 15, and 19 feet, respectively; West River, 10 feet, Mill River, 11 feet; Quinnipiac River to Ferry Street, 12 feet, and thence to Grand Avenue, 8 feet; and Brewery Street channel, 10½ feet. The total expenditure under the existing project to the end of the fiscal year was, for new work, \$528,024.94; for maintenance, \$136,009.08; total, \$664,034.02. The project has been completed for less than the estimate, the saving being \$194,675.06. The dike at Fort Hale bar is in fair condition.

Local cooperation.—No conditions for local cooperation were prescribed by law at the time of the adoption of the project. One municipal wharf, with limited facilities, has been constructed at a cost of approximately \$20,000. The upper portion of the West River Channel had been improved by private parties at a cost of about \$10,000 before its further improvement was undertaken by the United States. Extensive dredging has been done by the New York, New Haven & Hartford Railroad Co. to connect one of its coal-handling plants with the main channel.

Effect of improvement.—The improvement has secured for New Haven the benefit of very low water freight rates, particularly on bulk commodities. The present commerce of New Haven could not be carried on without the improvements made.

Proposed operations.—During the fiscal year ending June 30, 1917, it is proposed to restore to project dimensions the Mill River and

Brewery Street Channels and the West River Channel and Basin.
An estimate of the proposed work follows:

	Cu. yds.	
West River Channel and Basin-----	65, 000	
Mill River Channel-----	20, 000	
Brewery Street Channel-----	10, 000	
Total-----	95, 000 at 20 cents-	\$19, 000
Administration, inspection, and contingencies-----		2, 200
		<hr/> 21, 200

The above-described work is now urgently needed, and will exhaust the available funds. No maintenance work has been done in the 15-foot basin since its depth was increased from 12 to 15 feet in 1911. The rate of shoaling is at least 6 inches annually, so that by June 30, 1917, the depth will be only about 12 feet. This basin is much used by boats drawing 12 feet or more, and it is also necessary to cross it to reach the public wharf, where the city has dredged a berth 16 feet deep and is contemplating extensive enlargements of the terminal facilities. For these reasons the restoration of the basin to project depth will be urgently needed during the fiscal year for which estimate is made. Detailed estimate for funds required during the fiscal year ending June 30, 1918, follows:

Dredging 70,000 cubic yards at 18 cents-----	\$12, 600
Administration, inspection, and contingencies-----	1, 400
	<hr/> 14, 000

This amount is larger than the average expenditure for maintenance during the last three years by about \$3,500. A large part of the project has been completed during the last three years, hence in that time the maintenance has been small; the areas thus completed are now beginning to require restoration, and maintenance work may be expected to be increased hereafter.

Commercial statistics.—The principal items of freight for the calendar year were general merchandise, coal, lumber, and oysters, carried principally in vessels drawing from 8 to 22 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	2, 096, 135	\$123, 093, 132. 96
1914.....	1, 704, 854	105, 459, 519. 16
1915.....	1, 792, 856	99, 561, 097. 40

Amount expended on all projects from August 30, 1852 to June 30, 1916:	
New work-----	\$853, 720. 60
Maintenance-----	136, 009. 08
Total-----	<hr/> 989. 729. 68
July 1, 1916, balance available-----	21, 254. 93
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	14, 000. 00

BRIDGEPORT HARBOR, CONN.

Location and description.—On the north shore of Long Island Sound, about 57 miles east of New York City. The harbor consists of an outer main harbor about 3,500 by 4,000 feet; an inner harbor about 1 mile long and 1,500 feet wide, decreasing in width to 500 feet at the head; the navigable portions of Poquonock River, $1\frac{1}{2}$ miles long, and Yellow Mill Pond, two-thirds of a mile long, entering from the north; Johnsons River, three-fourths of a mile long, entering from the east; Black Rock Harbor, about one-half mile wide and 1 mile long, lying $2\frac{1}{4}$ miles west of the main harbor; and Cedar and Burr Creeks, $1\frac{1}{4}$ and one-half miles long, respectively, entering Black Rock Harbor from the north. (See United States Coast and Geodetic Survey chart No. 52.)

Condition at the end of fiscal year.—The following permanent works had been built: Four riprap breakwaters, two at the entrance to the main harbor, one between the outer and inner harbors, and one joining the mainland and Fayerweather Island; a stone breakwater with paved surfaces and similar sea wall joining the two portions of Fayerweather Island, and shore-protection works at the same island. The channels had been dredged to prescribed dimensions except at the inner ends of Johnsons River, Burr Creek, and Yellow Mill channels, and in the Poquonock River at East Washington Avenue Bridge. The project is 99 per cent completed. The controlling depths at mean low water are: Main channel, to just inside the inner breakwater, 21 feet, and thence 17 feet to the lower bridge; Poquonock River, $16\frac{1}{2}$ feet from Stratford Avenue to the East Washington Avenue bridge; through the bridge $11\frac{1}{2}$ feet; from a point 100 feet above the bridge to a point opposite Black's coal dock, 17 feet, and thence to the head of the improved channel, about 9 feet; Yellow Mill channel, $10\frac{1}{2}$ feet to Stratford Avenue, and thence 9 feet nearly to the head of the improved channel; Johnsons River, 9 feet to the turn above the shipyard, and thence about $6\frac{1}{2}$ feet to the head of the channel; Black Rock Harbor, $10\frac{1}{2}$ feet to the head of navigation in both branches of Cedar Creek; Burr Creek, about 5 feet to its head. To complete the project would require dredging the inner ends of the channels in Johnsons River, Yellow Mill Pond, and Burr Creek, where ledge rock exists, and at the East Washington Avenue Bridge, which is being rebuilt. The expenditures under the existing project to the end of the fiscal year were, for new work, \$516,239.64; for maintenance, \$69,930.58; total, \$586,170.22. The proportional cost of completed work is less than the estimate, the saving amounting to \$174,255.66. The improvement as it now exists was completed in 1911. The condition of the breakwaters and protective works is as follows: Inner breakwater, fair, no longer needed; east and west breakwaters, repairs needed; breakwater between mainland and Fayerweather Island, fair, will be rendered unnecessary by sea wall proposed by city; Fayerweather Island breakwater and sea wall, in need of repair; shore-protective works, Fayerweather Island, good, and serve their purpose.

Local cooperation.—No conditions for local cooperation were prescribed by law at the time of the adoption of the project or its modifications. Dredging, totaling quite an extensive amount, has been

done by private interests in various portions of the harbor, which has resulted in benefit to general navigation. The cost of this work is not known.

Effect of improvement.—The effect of the improvement is to afford the city of Bridgeport the advantages of water transportation at greatly reduced rates.

Proposed operations.—It is proposed, under an existing contract, to restore the Yellow Mill Channel to approximately project dimensions. This work will be completed during the present working season and will exhaust the balance unexpended June 30, 1916.

The breakwaters in the main harbor were completed in 1908; no repairs have since been made, and they have suffered from wave attack so that repairs are now needed. The breakwater and sea wall connecting the two portions of Fayerweather Island is in urgent need of repair. It is an old structure and is so built that if repairs are not promptly made the damage will rapidly increase. The Black Rock and Cedar Creek Channels were completed to present dimensions in 1911, and no maintenance dredging has since been done. Shoaling has taken place and these channels should be redredged. The project depth—12 feet—is the approximate draft of the vessels using these channels, and any diminution in this depth results in expensive delays. The following estimate is submitted for the fiscal year ending June 30, 1918:

Maintenance dredging, Black Rock and Cedar Creek Channels, 90,000 cubic yards, at 18 cents	\$16, 200
Repair of Fayerweather Island breakwater and sea wall, mainly labor	1, 000
Repair of breakwaters at entrance to main harbor, 3,000 tons of stone, at \$1.50	4, 500
Administration, inspection, and contingencies	2, 300
Total for maintenance	24, 000

The foregoing estimate is greater than the average expenditure for maintenance for the past three years, because no maintenance dredging has been done in Bridgeport Harbor, with the exception of a small amount in Burr Creek, since 1914. Economy requires dredging at intervals of several years rather than small amounts annually.

Commercial statistics.—The principal items of freight for the calendar year were general merchandise, coal, sand and stone, iron and steel, and petroleum products, carried in steamers, barges and scows, canal boats, and schooners, drawing from 5 to 20 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	1,083,047	\$43,727,073.50
1914.....	1,039,398	67,003,507.55
1915.....	1,135,623	71,061,781.90

Amount expended on all projects from July 4, 1836, to June 30, 1916:

New work	\$894, 689. 17
Maintenance	81, 879. 55

Total 976, 568. 72

July 1, 1916, balance available 2, 377. 23

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement 24, 000. 00

NORWALK HARBOR, CONN.

Location and description.—On the north shore of Long Island Sound, about 44 miles east of New York City. The harbor consists of a broad outer bay, also known as Sheffield Harbor; an inner harbor, about one-half mile wide and $1\frac{1}{2}$ miles long; and the tidal portion of Norwalk River, $1\frac{1}{2}$ miles long, narrow and crooked.

Condition at the end of fiscal year.—Channels of prescribed dimensions have been dredged. The existing project was completed in 1908. The branch channel to East Norwalk has shoaled considerably, but its restoration has not as yet been considered as justified by the needs of commerce. The controlling depths at mean low water are: $10\frac{1}{2}$ feet nearly to the Washington Street Bridge at South Norwalk, and thence 9 feet to the railroad bridge; $7\frac{1}{2}$ feet to Norwalk; and 4 feet to East Norwalk. The width of the channels is much diminished, particularly opposite the South Norwalk wharves and between them and Norwalk. The expenditures under the existing project to the end of the fiscal year are—for new work, \$44,365.49; for maintenance, \$19,914.07; total, \$64,279.56. The project has been completed for less than the estimate, the saving being \$19,134.51.

Effect of improvement.—The improvement is essential to the water-borne commerce of the locality and has effected a material reduction in freight rates.

Proposed operations.—It is proposed to apply the available funds, including those appropriated by the river and harbor act, approved July 27, 1916, to the restoration of the channels during the fiscal year ending June 30, 1917. The following itemization is submitted:

Maintenance dredging, channels to South Norwalk and Norwalk, 40,000 cubic yards, at 20 cents-----	\$8, 000. 00
Administration, inspection, and contingencies-----	1, 150. 86
Total -----	9, 150. 86

The above work will not be sufficient to restore the channels to full project dimensions. The following estimate is submitted for maintenance work during the fiscal year ending June 30, 1918:

Maintenance dredging, 28,000 cubic yards, at 25 cents-----	\$7, 000
Administration, inspection, and contingencies-----	1, 000
Total -----	8, 000

The existing channel dimensions are inadequate for commerce of the extent and character now using the waterway, hence it is very desirable to preserve the dimensions as fully as possible until such time as the project may be modified. The greatest deterioration has been in the width, particularly opposite the South Norwalk docks where maneuvering room is very necessary, and in the channel between South Norwalk and Norwalk, at best narrow and crooked.

Commercial statistics.—The principal items of freight for the calendar year were general merchandise, coal, oysters and shells, carried in steamers, barges, scows, schooners, and sloops, drawing from 4 to 15 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	247,968	\$22,568,126. 89
1914.....	206,467	11,463,619. 10
1915.....	237,391	33,174,097. 08

Amount expended on all projects from June 10, 1872, to June 30.

1916:		
New work		\$163,761. 60
Maintenance		35,430. 96
Total		199,192. 56
Balance available for fiscal year ending June 30, 1917.....		9,150. 86
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....		8,000. 00

NORWALK HARBOR, CONN.—NEW PROJECT.

Abstract from the report of the Chief of Engineers, printed in House Document 1143, Sixty-third Congress, second session:

The district officer states that the improvement now desired by the navigation interests of the harbor is a wider, straighter, and deeper channel to the wharves at South Norwalk. Interested parties have suggested a channel 500 feet wide and 16 feet deep, departing considerably from the lines of the present channel, but the district officer is of opinion that the channel dimensions specified are greater than necessary. He submits a plan providing for a straight entrance channel 12 feet deep and 200 feet wide up to Dorlons Point, thence a channel 12 feet deep and 150 feet wide to South Norwalk and 250 feet wide along the wharves at South Norwalk to the highway bridge; an anchorage basin 10 feet deep and about 17 acres in extent opposite the entrance to East Norwalk; and a channel 10 feet deep and generally 100 feet wide from South Norwalk to the head of navigation at Norwalk, at an estimated cost of \$206,000. He is of opinion that the locality is worthy of improvement to this extent, and the division engineer concurs in this opinion.

I concur with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement of Norwalk Harbor, Conn., is deemed advisable to the extent of providing a straight entrance channel 12 feet deep at mean low water and 200 feet wide up to Dorlons Point, thence 12 feet deep and 150 feet wide to South Norwalk, and 250 feet wide along the wharves at South Norwalk to the highway bridge; an anchorage basin 10 feet deep at mean low water and about 17 acres in extent opposite the entrance to East Norwalk; and a channel 10 feet deep and generally 100 feet wide from South Norwalk to the head of navigation at Norwalk, all as shown on accompanying map, at a total estimated cost of \$206,000 for first construction and \$8,000 annually for maintenance for the first three years and \$4,000 annually thereafter, including the maintenance of the existing channel 6 feet deep and 75 feet wide along the east side of the harbor to the head of navigation at East Norwalk.

HARBORS AT STAMFORD AND GREENWICH, CONN.

STAMFORD HARBOR, CONN.

Location and description.—On the north shore of Long Island Sound, 36 miles east of New York City. It consists of a bay about 2 miles wide at its mouth and extending inland 1½ miles, from which two tidal inlets, known as the east and west branches, 1½ and 1½ miles long, respectively, extend northerly into the city of Stamford.

The east branch, known locally as the "Canal" is largely artificial; the west branch is the tidal portion of Mill River a small fresh-water stream.

Existing project.—The project provides for a channel in the west branch 7 feet deep, 150 feet wide, and about $1\frac{1}{5}$ miles long, with a basin of the same depth between harbor lines at the head of the harbor, and in the east branch a channel 9 feet deep and 100 feet wide for a length of about 8,535 feet, and from about 80 to 125 feet wide for about 1,200 feet farther to the head of the harbor. The plane of reference is mean low water, the mean tidal range being 7.3 feet. The estimated cost of the entire improvement is \$123,500 for new work. There is no estimate for maintenance.

Condition at the end of fiscal year.—The channels and anchorage basin were dredged to prescribed dimensions and the project was completed in 1911, at a cost of \$8,457.15 less than the estimate. The controlling depths at mean low water are: In the east branch, $8\frac{1}{2}$ feet to the steamboat wharf, thence diminishing to 3 feet at the extreme head, 1,200 feet above; in the west branch, 7 feet to the basin, in which the available depth ranges from 5 to $6\frac{1}{2}$ feet. The channel widths have seriously diminished. The expenditures under the existing project to the end of the fiscal year are: For new work, \$115,042.85; for maintenance, \$35,027.02; total, \$150,069.87.

Local cooperation.—No conditions of local cooperation were prescribed by law at the time of the adoption of the project. Prior to the adoption of the original project a channel of $6\frac{1}{2}$ feet deep and 60 feet wide had been dredged to the head of the east branch by private interests, at a cost said to be about \$250,000.

Effect of improvement.—The improvement has afforded the city of Stamford increased facilities for water transportation, with a consequent reduction in freight rates.

Proposed operations.—It is proposed to expend the available funds during the next fiscal year in restoring to project depth those portions of the east branch channel and the basin at the head of the west branch where the greatest shoaling has taken place, the funds not being sufficient to complete the restoration to project dimensions. Estimate follows:

Dredging 38,000 cubic yards at 25 cents_____	\$9, 500
Administration, inspection, and contingencies_____	1, 057
	<hr/> 10, 557

No maintenance dredging has been done since the project was completed in the east branch in 1908 and in the west branch in 1911. Since then the channel widths have been much reduced by inflow from the banks and the depths at the head of both branches have seriously diminished. Full project dimensions are inadequate for present needs and any reduction seriously impairs the usefulness of the harbor. The available funds are insufficient to remove half of the filling which has taken place since the project was completed, and the following estimate is submitted for the fiscal year ending June 30, 1918:

Dredging 50,000 cubic yards at 25 cents_____	\$12, 500
Administration, inspection, and contingencies_____	1, 500
	<hr/> 14, 000

The above amount is in excess of the average amount expended for maintenance during the past three years, because during that time there had been no maintenance dredging. A new project was under consideration and before Congress; had funds for this project been appropriated it would have been much more economical to have included the maintenance dredging with the new work.

Commercial statistics.—The principal items of freight for the calendar year were general merchandise, coal, sand and stone, earths, ores, and acids, carried in steamers, barges, scows, canal boats, and schooners, drawing from 6 to 15 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	332,576	\$15,984,034.84
1914.....	263,331	10,456,050.03
1915.....	356,768	17,843,810.04

Amount expended on all projects from Aug. 5, 1886. to June 30, 1916:	
New work.....	\$135,142.85
Maintenance	35,027.02
Total.....	170,169.87
July 1, 1916, balance available.....	10,557.59
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	
	14,000.00

GREENWICH HARBOR, CONN.

Location and description.—On the north shore of Long Island Sound, about 30 miles east of New York City. The harbor consists of a shallow cove, varying in width from about 1,500 to 200 feet, extending northward about 3,000 feet from a broad outer bay known as Captains Harbor.

Existing project.—The project provides for a channel 90 feet wide from a point in the outer bay to the causeway at the head of the harbor, a distance of about a mile, to be 9 feet deep to the steamboat dock and 6 feet deep above, the upper end to be enlarged to form a turning basin. The plane of reference is mean low water, the mean tidal range being 7.5 feet. The estimated cost of the improvement is \$20,000, with no estimate for maintenance. The plan of improvement is printed in House Document No. 25, Fifty-third Congress, third session, and was adopted by the river and harbor act of June 3, 1896. For map see House Document No. 289, Sixty-third Congress, first session.

Condition at the end of fiscal year.—The channels and turning basin were dredged to the prescribed dimensions and the project completed in 1905. The controlling depths at mean low water are 8½ feet to the steamboat wharf and 7 feet to the head of the dredged channel; in the upper part of the turning basin, 3½ feet. The available channel width is in many places much reduced. The expenditures to the end of the fiscal year are, for new work, \$17,017.19; for maintenance, \$10,226.60; total, \$27,243.79. The project has been completed for less than the estimate by \$2,982.81.

Local cooperation.—No conditions for local cooperation were prescribed by law at the time of the adoption of the project. A small amount of dredging has been done by private interests at an unknown cost that has tended to reduce the cost of subsequent operations by the United States.

Effect of improvement.—The improvement has afforded the town of Greenwich added facilities for water transportation and has tended to reduce freight rates.

Proposed operations.—The channel has shown unexpected permanence since the last maintenance work in 1913, and no operations are proposed during the next fiscal year. The channel dimensions named in the existing project are insufficient for the present commerce, hence it is very desirable to fully maintain them. The following estimate for the fiscal year ending June 30, 1918, is submitted:

Dredging 10,000 cubic yards, at 25 cents.....	\$2, 500
Administration, inspection, and contingencies.....	500
	<hr/> 3, 000

Commercial statistics.—The principal items of freight for the calendar year were coal, general merchandise, sand and stone, and building materials, carried in steamers, scows, barges, canal boats, and schooners drawing from 6 to 13 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	116,570	\$8,582,337.00
1914.....	119,677	6,550,723.00
1915.....	96,632	2,656,780.58

Financial summary.

Amount expended on all projects from June 3, 1896, to June 30, 1916:

New work.....	\$17,017.19
Maintenance.....	10,226.60
Total.....	<hr/> 27,243.79

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....

3,000.00

GREENWICH HARBOR, CONN.—NEW PROJECT.

The following report of the Board of Engineers, in which the Chief of Engineers concurs, is printed in House Document 289, Sixty-third Congress, first session:

Greenwich Harbor has been improved under a project adopted by the act of June 3, 1896, which provides for a channel 90 feet wide from deep water to the causeway at the head of the harbor, a distance of about 1 mile, 9 feet deep to the steamboat dock and 6 feet deep for the remainder of the distance, the upper end being enlarged to form a turning basin. This project was completed in 1905, and has since been maintained.

The commerce of the locality has ranged from 76,000 to 146,000 tons, averaging about 100,000 tons. A regular freight steamer plies between Greenwich and New York and handles about 25,000 tons, the balance being carried in barges and schooners, which land their cargoes principally in the upper part of the

harbor. The present depth is insufficient to meet the needs of these vessels, and the district officer presents a plan of improvement designed to afford more adequate facilities. He proposes a channel 12 feet deep to the upper wharves, to be 130 feet wide in the outer harbor and 100 feet wide along the water front, at an estimated first cost of \$35,000, and \$2,250 per annum for maintenance. As the extreme upper end of the harbor is used only for private purposes, it is proposed to carry the channel only to a point about 475 feet below the head of the existing project. The district officer believes the locality worthy of improvement to the extent outlined above, and in this view the division engineer concurs.

From the facts presented it appears that the existing project is inadequate to meet the reasonable demands of commerce and navigation. The total expenditures to June 30, 1912, have been \$23,343.17, quite a moderate sum when compared with the commerce affected. It is believed that the additional improvement now desired is justified by the interests involved, and therefore the board concurs with the district officer and the division engineer in the opinion that it is advisable to modify or extend the existing project for Greenwich Harbor so as to provide a channel 12 feet deep to the upper wharves, 130 feet wide in the outer harbor and 100 feet wide along the wharf front, as shown on accompanying map, at an estimated first cost of \$35,000, and \$2,250 for annual maintenance.

THAMES RIVER, CONN.

Location and description.—Thames River is a tidal estuary varying in width from about 400 feet to three-fourths of a mile, and extending from the junction of the Yantic and Shetucket Rivers at Norwich, Conn., 15 miles southerly to Long Island Sound at New London. The lower 3 miles constitutes New London Harbor. The improvement embraces the remaining 12 miles.

Condition at the end of fiscal year.—The project is completed, providing a channel 200 feet wide, 20 feet deep and 6 miles long, from New London Harbor to Allyn's Point; thence 200 feet wide and 14 feet deep, 6 miles farther to the head of navigation at Norwich. The training walls have been completed except the upper end of the Rolling Mill Dike, replaced by adjacent shore improvements. The controlling depths at mean low water are 20 feet to Allyn's Point, thence to Norwich 13.5 feet, and 12 feet in the Shetucket River to the town dock. The expenditures under the existing project up to the end of the fiscal year are, for new work, \$447,424.51; for maintenance, \$84,037.13; total, \$531,461.64. The project was completed in 1912. The cost of the completed improvement is \$66,647.23, or 13 per cent less than the estimate.

Local cooperation.—No conditions for local cooperation were prescribed by law at the time of the adoption or modification of the project. In 1835–36 the Merchants' Bank of Norwich expended \$3,679 in dredging channels in the vicinity of Norwich, and in recent years considerable amounts of dredging have been done by private interests to connect their wharves with the channels provided by the United States.

Effect of improvement.—The work done has reduced the cost of transportation by increasing the available draft from 8 feet to 16 and 22 feet. The river commerce of the present day could not be carried except for the increased depths thus obtained.

Proposed operations.—It is proposed to apply the available funds, appropriated by the river and harbor act of July 27, 1916, to dredging in the channel between Allyn's Point and Norwich where shoal-

ing has taken place. It is proposed to do the following work during the fiscal year ending June 30, 1917:

Dredging between Allyn's Point and Norwich, 34,000 cubic yards, at 24 cents-----	\$8,160
Administration and inspection-----	840
	<hr/> 9,000

The last dredging above Allyn's Point was done in 1912, and since that time much shoaling has taken place. Navigation interests require the full project depth. The work referred to above will not complete the necessary maintenance dredging, and the following estimate is submitted for work during the fiscal year ending June 30, 1918:

Dredging channel at Long Reach and between Allyn's Point and Norwich, 32,000 cubic yards, at 24 cents-----	\$7,680
Administration, inspection, and contingencies-----	1,320
	<hr/> 9,000

Commercial statistics.—The principal items of freight for the calendar year were coal, paper stock, general merchandise, and lumber, carried principally in steamers, barges, and schooners drawing from 12 to 21 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	650,554	\$9,114,246.54
1914.....	490,605	8,110,426.50
1915.....	389,161	9,646,479.75

Amount expended on all projects from July 4, 1836, to June 30, 1916:

New work-----	\$487,724.51
Maintenance-----	84,037.13
Total-----	<hr/> 571,761.64

Amount appropriated by river and harbor act approved July 27, 1916-----

1916-----	9,000.00
Balance available for fiscal year ending June 30, 1917-----	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	9,000.00

CONNECTICUT RIVER BELOW HARTFORD, CONN.

Location and description.—This river has its source at Connecticut Lake, in northern New Hampshire, flows southerly 375 miles, and empties into Long Island Sound at Saybrook, Conn., 14 miles west of New London. Hartford, now the head of commercial navigation, is 51.9 miles by channel from the mouth.

Existing project.—In accordance with a plan in House Document No. 1294, Sixty-first Congress, third session, the project was modified by the river and harbor act of February 27, 1911, to provide for increased channel depth, to be maintained by dredging, and the construction of permanent works. The project now provides for a channel 300 feet wide, 15 feet deep at mean low water, and about six-tenths mile long across the bar at the mouth, and thence 100 feet wide and 12 feet deep at mean low water (2 feet on the Hartford gauge) for

51.3 miles to Hartford; the channels to be obtained by dredging and the construction of dikes, training walls, and revetments; and for two riprap jetties at the mouth of the river, the tops to be 5 feet above high water and 6 feet wide. The estimated first cost, exclusive of the expenditures reported in the preceding paragraph, is \$177,000; the estimated cost of maintenance is \$15,000 per annum until the dikes and training walls are completed and \$7,000 per annum thereafter. The mean tidal range is 3.4 feet at the mouth and, on low water, 1.2 feet at Hartford. For map, see Annual Report for 1913, page 1602.

Condition at end of fiscal year.—Two parallel jetties at Saybrook, training walls at Hartford, Clay Banks, Glastonbury, and Sears Shoal, and spur jetties at Press Barn, have been constructed; the bank at Cys Hollow has been revetted; and a channel has been dredged 300 feet wide and 15 feet deep through the bar at the mouth of the river, and thence 12 feet deep and 100 feet wide to Hartford. The existing project is about 80 per cent completed. On June 30, 1916, the controlling depths at mean low water were 15 feet across the Saybrook bar and thence 10½ feet to Hartford. Owing to freshet the available depth to Hartford has been 12 feet or more since the opening of navigation this spring. The expenditures under the existing project to the end of the fiscal year are: For new work, \$139,030.89; for maintenance, \$99,342.44; total, \$238,373.33. The jetties, training walls, dikes, and revetment are in fair condition, except that the east jetty at Saybrook needs extensive repairs. Some minor repairs are needed to the west jetty and some of the other structures named above.

Local cooperation.—No conditions for local cooperation were prescribed by law. On various occasions between 1884 and 1904, when funds for maintenance were lacking or insufficient, channels through the various bars sufficient to pass a regular line of steamboats were maintained by dredging by the Hartford & New York Transportation Co., at a cost of \$28,384.18. Previous to 1868 dredging and regulation work were done by private and municipal interests at a cost in excess of \$93,000.

Effect of improvement.—The work done has afforded the city of Hartford and other river ports the advantage of water transportation and has effected a reduction in the rates on bulk commodities.

Proposed operations.—It is proposed to apply the funds available after the completion of the maintenance dredging now in progress, including funds appropriated by the river and harbor act approved July 27, 1916, to repairing the west jetty at Saybrook, to minor repairs to other training walls, dikes, and revetments, and to the maintenance of the channels. It is expected that the following work will be completed or under contract and the available funds expended or covered before the end of the fiscal year ending June 30, 1917:

1,200 tons riprap stone in place, at \$1.75-----	\$2, 100. 00	
Repairs to spur dikes and revetment-----	200. 00	
Administration, inspection, and contingencies-----	239. 34	
		\$2, 539. 34
Dredging, 90,000 cubic yards, at 15 cents-----	13, 500. 00	
Administration and inspection-----	1, 500. 00	
		15, 000. 00
Total available funds-----		17, 539. 34

It is proposed to apply the funds for which estimate is submitted to the maintenance of the river channel, to the repair of the east jetty at Saybrook, and to the revetment of the Press Barn reach. Maintenance of project depth requires annual dredging after the subsidence of the spring freshet. Without such dredging the present passenger and freight traffic could not be carried on. The Saybrook jetties are necessary to protect and maintain the entrance channel. The east jetty, never built to full project cross section, has had no repairs since 1905, and such work is now badly needed. If repairs are not made, not only will the petty rapidly deteriorate but the channel will be endangered. Revetment of the Press Barn reach is needed to keep the channel in its present position. The southerly bank of this reach is cutting at the rate of from 25 to 50 feet per year, with the result that the channel is not only constantly changing, but is filled by the eroded material. The following estimate for the above-named work is submitted, arranged in the order of its relative importance:

Dredging 80,000 cubic yards, at 15 cents-----	\$12, 000
10,000 long tons riprap, for repair of east jetty at Saybrook, at \$1.75---	17, 500
Administration, inspection, and contingencies-----	3, 500
For maintenance-----	33, 000
Revetment of Press Barn reach, 5,300 linear feet, including administration and inspection, at \$7 per linear foot, for new work-----	37, 100
Total estimate-----	70, 100

Commercial statistics.—The principal items of freight for the calendar year were coal, general merchandise, stone, and fertilizer, carried principally in barges and steamers drawing 10 to 12 feet.

Comparative statement.

[Including Eightmile River.]

Calendar year.	Short tons.	Value.
1913.....	644, 633	\$38, 843, 681. 52
1914.....	559, 728	35, 193, 842. 88
1915.....	641, 562	39, 835, 837. 24

Amount expended on all projects from July 4, 1836, to July 30, 1916:

New work-----	\$426, 405. 18
Maintenance -----	465, 690. 91

Total -----	892, 096. 09
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Balance available for fiscal year ending June 30, 1917-----	17, 539. 34
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Amount (estimated) required to be appropriated for completion of existing project-----	37, 969. 00
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Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement-----	37, 100. 00
For maintenance of improvement-----	33, 000. 00

Total -----	70, 100. 00
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HOUSATONIC RIVER, CONN.

Location and description.—The river rises in northwestern Massachusetts, flows south 130 miles through Massachusetts and Connecticut, and empties into Long Island Sound at Stratford, 5 miles east of Bridgeport Harbor.

Condition at the end of fiscal year.—The project is about 93 per cent completed. The breakwater at the mouth of the river is of project length; the inner arm of project cross section and the outer arm of project height but with top width of 8 feet and outer slope of 1 on $1\frac{1}{2}$, instead of the full project dimensions, the lesser dimensions having proved sufficient; the Stratford Dike is 1,115 feet long, a small jetty has been built at Sow and Pigs Rocks, and the channel has been dredged to project dimensions. The controlling depths are, at mouth of river, 7 feet, and thence 5 feet to Shelton. To complete the project requires the enlargement of the outer arm of the breakwater to provide a top width of 12 feet and an outer slope of 1 on 2, which is not required for permanence, and the extension of the Stratford dike not more than 385 feet. The expenditures to the end of the fiscal year have been, for new work, \$228,664.26; for maintenance, \$103,575.48; total, \$332,239.74. The proportionate cost of completed work is less than the estimate, the saving amounting to \$27,085.74. The improvement as it now exists was completed in 1914. The breakwater, dike, and jetty are in good condition.

Local cooperation.—No conditions for local cooperation were prescribed by law at the time of the adoption of the project or its modifications. A considerable amount of dredging has been done by private parties at the outer bar to obtain material for oyster beds, the cost and extent of which is not known.

Effect of improvement.—The improvement has afforded the towns of Stratford, Derby, and Shelton the advantage of water transportation of bulk freight, and has had the effect of materially reducing the freight rates to these points.

Proposed operations.—It is proposed to apply the available funds, including the funds appropriated by the river and harbor act approved July 27, 1916, to restoring the bar channels to full project dimensions and to the extension of the Stratford dike not to exceed 200 feet. It is estimated that the following work will be done during the fiscal year ending June 30, 1917, which will exhaust the available funds:

Maintenance dredging, 28,000 cubic yards, at 30 cents----	\$8, 400. 00	
Administration, inspection, and contingencies-----	825. 66	
		\$9, 225. 66
Extension of Stratford dike, 4,000 tons of riprap stone in place, at \$1.40-----	5, 600. 00	
Administration, inspection, and contingencies-----	400. 00	
		6, 000. 00
Total available funds-----		15, 225. 66

The constantly increasing commerce of this river (now reported larger by 25,000 tons than at any time during the past 12 years) is greatly hampered by even a very slight deterioration of the channel. Frequent (usually annual) dredging is necessary to preserve the project dimensions. The extent of the shoaling is dependent on

freshets, hence the amount of dredging can not be definitely foreseen. Sufficient funds should be on hand when navigation opens in the spring to quickly restore the channels to project dimensions. The following estimate for dredging in the fiscal year ending June 30, 1918, is based on past experience:

Maintenance dredging, 24,000 cubic yards, at 30 cents	\$7, 200
Administration, inspection, and contingencies	800

Total estimate, for maintenance	8, 000
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Commercial statistics.—The principal items of freight for the calendar year are coal, petroleum products, and oyster shells, carried principally in steamers, barges, and schooners drawing from 6 to 9½ feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	114, 183	\$1, 023, 558. 99
1914.....	114, 988	1, 131, 813. 54
1915.....	141, 583	1, 549, 338. 10

Amount expended on all projects from March 3, 1871, to June 30, 1916:

New work	\$228, 664. 26
Maintenance	103, 575. 48

Total	332, 239. 74
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Balance available for fiscal year ending June 30, 1917	15, 225. 66
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Amount (estimated) required to be appropriated for completion of existing project	40, 836. 00
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	8, 000. 00
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PORT HENRY HARBOR, N. Y.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document No. 369, Sixty-fourth Congress, first session:

Port Henry is located on the southwest shore of Lake Champlain, 2 miles northwest of Crown Point. It is the distributing point of the Port Henry iron-ore district, the principal mines being at Mineville, about 6 miles back from the lake shore and connected with Port Henry by rail. The annual shipments of ore during the past three years have averaged about 800,000 tons, and the receipts, chiefly coal and merchandise, have averaged from 125,000 to 170,000 tons. Only about 5 per cent of this commerce is now handled by water, on account of the small depth of Lake Champlain Canal, but the enlargement of this canal to a depth of 12 feet is approaching completion. To assist in the development of the port the State of New York has adopted a project for the construction of a modern terminal at considerable cost. The present depth of water along the wharves is from 5 to 6 feet at low lake level, gradually increasing to the eastward. The district officer, who is also the division engineer, believes that the harbor should be given a depth sufficient to permit its use by boats of the maximum dimensions which the canals admit. He submits a project providing ultimately for the dredging of a strip 1,000 feet wide, covering an area of about 50 acres, to a depth of 12 feet at low lake level, and protecting this area by a breakwater, at a total estimated cost of \$385,500. Pending the development of a commensurate commerce, however, he proposes to limit the improvement to the dredging of a strip 500 feet wide, covering an area of about 40 acres, at a total estimated cost of \$81,500, of which local interests offer to pay \$10,000.

I concur in general with the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of harbor at Port Henry, N. Y., is deemed advisable to the extent of dredging a strip 500 feet in width and 12 feet deep at low lake level, covering an area of about 40 acres, and indicated by the letters A, B, C, D, E, and F on the accompanying map, at a total estimated cost of \$81,500, provided that no work shall be undertaken until local interests have contributed \$10,000 toward the cost of the work.

OGDENSBURG HARBOR, N. Y.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document No. 663, Sixty-fourth Congress, first session:

The present project for improvement of this harbor, adopted by the river and harbor act approved June 25, 1910, and completed in 1913, provides for deepening the several channels of the harbor to 19 feet at low water and for removing wholly the middle ground between the two lower entrance channels, at an estimated cost of \$187,970. Under this and prior projects the United States has provided an upper entrance channel, a lower entrance channel and basin, and a channel about 1 mile in length along the city front wharves connecting the two entrances, all to a depth of 19 feet below low water on the Ogdensburg gauge. The upper entrance channel has a width of from 300 to 450 feet, the narrowest part being at its inner end, where it joins the channel along the city front. The district officer states that there is difficulty in navigating around the bend at the junction of these channels, and there is also some difficulty at times in navigating the portion of the city front channel to the west of Caroline Street, where it abruptly decreases in width from 350 to 200 feet. The necessary relief would be afforded by widening this part of the channel to 350 feet, easing the bend at the junction and widening the inner end of the upper entrance channel to 400 feet. The district officer estimates the cost of this work at \$54,000. He believes that the expenditure involved is justified by the commercial importance of the harbor, which has a traffic of about 1,000,000 tons a year, and in this opinion the division engineer concurs.

I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Ogdensburg Harbor, N. Y., with a view to removing the point in the bend of the channel at the inner end of the upper entrance channel, opposite the mouth of the Oswegatchie River, and widening the channel is deemed advisable to the extent of widening the inner end of upper entrance to 400 feet, easing the bend at the junction of the upper entrance channel and city front channel, and widening the city front channel west of Caroline Street to 350 feet, approximately as indicated on the accompanying map, at a total estimated cost of \$54,000 for first construction and \$1,000 annually for maintenance.

PORT CHESTER HARBOR, N. Y.

Location and description.—Port Chester Harbor, located at the boundary between the States of New York and Connecticut, about 32 miles, by water, east of the Battery, New York City, consists of the Byram River and a shallow bay at its mouth, about 100 acres in extent, opening into Long Island Sound. About 1 mile above its mouth, at the head of navigation, the river is crossed by a fixed bridge.

Existing project.—The existing project for improvement was adopted by river and harbor act of June 25, 1910 (H. Doc. No. 1165, 60th Cong., 2d sess., with map). It provides for a channel 150 feet wide and 12 feet deep at mean low water from Long Island Sound to the southerly point of Fox Island; thence 100 feet wide and 10 feet deep to 900 feet below the fixed bridge at Mill Street, including

a turning basin opposite the steamboat landing; and thence 175 to 100 feet wide and 3 feet deep to 100 feet below the fixed bridge. Estimated cost, \$188,000, and \$2,500 annually for maintenance. The length of the section included in the project is about $1\frac{5}{8}$ miles. Mean tidal range, 7.29 feet.

Condition at the end of fiscal year.—The work done under all projects resulted in the removal in 1873 of Salt Rock to a depth of 9 feet; the completion in 1894 of a rubblestone breakwater at Byram Point about 700 feet long; the removal to a depth of 10 feet of several areas of ledge rock obstructing the channel at and above Fox Island; and in dredging the channel where most needed from 1,900 feet below Fox Island to Willet Avenue, near the head of navigation. The breakwater is in good condition and serves its purpose. As the result of these improvements, navigation through the channel has been rendered safer and vessels of increased draft are employed in the commerce of the harbor. On June 30, 1916, there was available for navigation a channel of navigable width and 12 feet depth up to Fox Island; thence about 9 feet up to about 1,800 feet above Fox Island; thence 8 feet to about 700 feet below the steamboat wharf; thence to Willet Avenue 10 feet; above this no work has been done, and the existing depths are 2 feet or less. Up to June 30, 1916, about 47 per cent of the work proposed under the existing project had been completed, and the total expenditures thereunder amounted to \$89,482.86—\$87,794.44 for new work, \$1,668.30 for maintenance, and \$20.12 for maps, for which the appropriation was reimbursed by receipts from sales.

To complete the project dredging remains to be done throughout the whole length of the channel and a number of obstructing ledges of rock at and above Fox Island require removal.

Local cooperation.—No conditions have been imposed by law requiring local cooperation. About 1893 the local authorities, aided by private interests, expended \$1,200 in dredging the channel above Fox Island previously excavated by the United States.

Effect of improvement.—As the result of the improvement, transportation by water has been rendered easier and safer, while the draft and registered tonnage of the largest vessels entering the harbor have increased. The financial benefits to the locality are indicated by the amount saved through the use of water instead of rail transportation for coal, iron, cement, sand, gravel, stone, brick, and lumber. This saving amounted to about \$154,700 in 1915.

Proposed operations.—The funds available June 30, 1916, together with those appropriated by the river and harbor act of July 27, 1916, will be expended for dredging in the channel opposite and below steamboat wharf to remove the bar which obstructs the approach to the wharves on the east side of the river and for removing rock projecting into the channel in the vicinity of Fox Island. It is expected that this work will be commenced in the fall of 1916, and that the funds will be exhausted by May 1, 1917.

The dredged channel below Fox Island is narrow and navigation through it is made difficult by sharp bends. At and above Fox Island the channel is narrowed by projecting ledges. These conditions should be remedied as soon as practicable. The funds, for which

estimate is submitted in this report, will be expended for this purpose as soon as available, as follows:

Dredging channel below Fox Island.....	\$16,000
Continuing rock removal in channel at and above Fox Island.....	10,000
Total.....	26,000

Commercial statistics.—As the result of a careful canvass it appears that the tonnage and value of the commerce of this harbor, mainly in general merchandise, building materials, fuel, and raw materials, are as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	195,605	\$6,359,430
1914.....	199,128	5,055,017
1915.....	206,556	9,976,999

Possengers carried: None reported.

Amount expended on all projects from June 10, 1872, to June 30, 1916:

New work.....	\$162,814.56
Maintenance.....	18,037.42
Total.....	180,851.98

Balance available for fiscal year ending June 30, 1917.....	28,160.73
Amount (estimated) required to be appropriated for completion of existing project.....	72,032.52
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement.....	26,000.00

PEEKSKILL HARBOR, N. Y.

Location and description.—This harbor is an indentation about five-eighths of a mile long and $1\frac{1}{4}$ miles wide in the eastern shore of the Hudson River, about 42 miles above the Battery, New York City. Peekskill Creek, whose source is about 14 miles northeast of the harbor, empties into the Hudson River about one-half mile northwest of the wharves in Peekskill. The mouth of the creek up to Annsville is known locally as Annsville Creek, and the upper section, above the highway at Tompkins Corners, as Peekskill Hollow Creek. The mouth of the creek is crossed by a bridge with draw span built by the New York Central Railroad.

Condition at the end of fiscal year.—The project was completed in 1899 at a cost of \$19,400, which is \$30,600 less than the estimated cost. The improved channel has a length of about 4,300 feet in the northern arm, 1,700 feet along the water front, and about 3,500 feet in the southern arm. The maximum mean low-water depth available for navigation was about 9 feet. To June 30, 1916, the expenditures amounted to \$30,428.79—\$19,400 for new work; \$11,026.19 for maintenance; and \$2.60 for maps, for which the appropriation was reimbursed by receipts from sales.

Local cooperation.—There have been no conditions imposed by law requiring local cooperation. Prior to 1913 the local authorities ex-

pended \$909 in removing shoals formed by the deposit of sewage, and private interests expended \$150,000 in the construction of a public wharf and \$10,000 in dredging in front of it.

Effect of improvement.—The improvement has resulted in competition which holds freight rates at a reasonable figure. The financial benefits to the locality are indicated by the amount saved through the use of water instead of rail transportation for brick, cement, sand, crushed stone, paving blocks, lumber, iron (pig and scrap), cast iron and steel manufactures, grain, and coal. This saving amounted to about \$53,400 in 1915.

Proposed operations.—The funds available June 30, 1916, together with funds appropriated by the river and harbor act of July 27, 1916, will be expended in dredging for maintenance. An examination made in June, 1916, shows that shoaling has occurred practically throughout the whole length of the dredged channel; these funds will not be sufficient to restore it to its projected dimensions. It is estimated that to accomplish this \$3,500 will be required. The following estimate of funds for the fiscal year ending June 30, 1918, is accordingly submitted:

Dredging for maintenance-----	\$3, 000
Engineering, superintendence, and contingencies-----	500
Total -----	3, 500

The last work done in this locality was for maintenance and was completed in November, 1911.

Commercial statistics.—As the result of a careful canvass in 1916 it appears that the commerce of this harbor, mainly in building materials, coal, iron and steel and manufactures, is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.	Passengers carried.
1913 ¹	308,173	\$9,880,198	(²)
1914.....	127,752	2,402,275	8,020
1915.....	152,854	3,777,619	22,417

It would seem from the investigation made during the canvass of 1915 that the statistics for 1913 are unreliable.

² None reported.

Amount expended on all projects from June 3, 1896, to June 30, 1916:

New work-----	\$19,400. 00
Maintenance-----	11,028. 79
Total-----	30,428. 79

Balance available for fiscal year ending June 30, 1917-----	2,555. 11
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	3,500. 00

NEW YORK HARBOR: AMBROSE, MAIN SHIP, BAYSIDE, AND GEDNEY CHANNELS.

Location and description.—The works included under the above title are in the Lower Bay, New York Harbor. The distance of the Lower Bay from Boston Harbor, Mass., by water is 330 miles,

southwest; the distance by water from the entrance to Delaware Bay, N. J. and Del., is 165 miles, northeast. New York Harbor consists of the Upper Bay, 4 miles long and 4 miles wide, connected with the Lower Bay by the Narrows, over a mile in width. The Lower Bay is triangular, extending 12 miles inland, with one side about 6 miles long open to the sea, from which it is separated by a broad bar crossed by five channels. Two of these channels have been improved under this title—Ambrose Channel and the Gedney-Bayside Channel, with its extension, Main Ship Channel. The inner end of these channels is 10 miles south from the Battery, New York City.

Existing project.—The existing project provides for deepening by dredging two entrance channels to New York Harbor, as follows:

(a) An entrance via Main Ship-Bayside-Gedney Channel, to be 1,000 feet wide and 30 feet deep at mean low water; mean rise of tide, $4\frac{1}{2}$ feet; length, about $10\frac{1}{2}$ miles. The estimated cost of original work was \$1,490,000 (Annual Report for 1887, pt. 1, p. 62) and of maintenance \$100,000 a year. The first appropriation was made by act of Congress dated July 5, 1884. The dimensions were fixed by the Secretary of War December 27, 1886, under authority of act of Congress of August 5, 1886 (Annual Reports for 1887, pt. 1, p. 62, and 1888, pt. 1, p. 63); date of adoption, July 5, 1884.

(b) An entrance via Ambrose (formerly East) Channel, to be 2,000 feet wide and 40 feet deep at mean low water; mean rise of tide, $4\frac{1}{2}$ feet; length, about $7\frac{1}{2}$ miles. The estimated cost of original work was \$6,688,000 (H. Doc. No. 159, 55th Cong., 3d sess., p. 2); the expenditure originally authorized was \$4,000,000, increased to \$5,148,510 by act of Congress of March 2, 1907. This part of the project was adopted by the river and harbor act of March 3, 1899. Map of Ambrose Channel is printed at page 1734 of Annual Report for 1914.

(c) The river and harbor act of June 25, 1910, appropriated \$200,000 for "Improving New York Harbor, N. Y., for maintenance, including Ambrose Channel." Similar provisions in the successive river and harbor acts of 1911, 1912, and 1913 have combined the maintenance of the entrance channels under one head. As nearly as can now be estimated, the annual cost of this maintenance will not exceed \$200,000. (Annual Report for 1914, p. 241.)

Condition at the end of fiscal year.—The existing project is entirely completed—the Main Ship-Bayside-Gedney Channel in 1891 and Ambrose Channel in 1914. The depth in the Main Ship-Bayside-Gedney Channel has been increased from 23.7 feet to 30 feet. The width, dredged to 1,000 feet, has since decreased to 500 feet in the narrowest part of Main Ship Channel. The depth in Ambrose Channel has been increased from 16 feet to 40 feet over a width of 2,000 feet, and has been fully maintained. The maximum draft which can now be carried through these channels at mean low tide is: Main Ship-Bayside-Gedney Channel, $30\frac{1}{2}$ feet; Ambrose Channel, 40 feet. Ships under steam are liable to draw from 1 to 4 feet or more in excess of their drafts at piers. The 30-foot channel was constructed at 2 per cent above the estimated cost, due to shoaling during progress. The 40-foot channel, estimated to cost \$6,688,000, was constructed at a saving of about \$1,500,000. In the table following is shown the total expenditures to June 30, 1916:

Local cooperation.—None has been required. The city of New York has built and owns many piers along the water front, and it is constantly increasing its investment in these structures. Some of these piers are built for special lessees; many of them are leased under competitive offers; a few are open to transient vessels at stated rates. The cost or value of these piers is difficult to estimate; it amounts to many millions of dollars. Municipalities in the State of New Jersey, and the State itself, are preparing for similar works.

Effect of improvement.—The effect upon freight rates is not traceable, being obscured by various other causes. The improvement has made it possible for the largest ships to enter and leave at all normal stages of tide; without it none of them would have been able to enter or leave the harbor when loaded.

Proposed operations.—The funds now available for maintenance, including Ambrose Channel, Gedney and Main Ship Channels, will be applied to maintenance of New York Harbor by collection and removal of drift, under authority of the river and harbor act of 1915, involving expenditures of approximately \$5,000 a month during summer and \$3,000 a month during winter, and to removal of shoals in the channels as they may occur. The funds available for Ambrose Channel will meet all anticipated expenditures until June 30, 1918, and no further appropriation is now needed. These funds will be applied to the maintenance of United States plant when not at work, and to removal of shoals should any be found in the channel.

The funds estimated for profitable expenditure during the year ending June 30, 1918, it is proposed to apply to maintenance by collection and removal of drift, at the rates of expenditure above named, and to removal of shoals such as may be found to obstruct the channels.

Commercial statistics.—No complete record of domestic or coast-wise commerce are available. The following table contains a record of foreign commerce only:

Projects for Main Ship, Bayside, and Gedney Channels and maintenance, including Ambrose Channel.

	For new work.	For maintenance.	Total.
30-foot entrance.....	¹ \$1,634,554.52	\$1,179,446.81	\$2,814,001.33
40-foot entrance.....		557,848.75	557,848.75
40-foot entrance ²	1,634,554.52 ³ 5,210,358.30	1,179,446.81 192,365.55	2,814,001.33 5,402,723.85
Total.....	6,844,912.82	1,371,812.36	8,216,725.18

¹ Includes \$116,530 applied to removing wreck and sunken rock, 1868 and 1873 (H. Doc. No. 1491, 63d Cong., 3d sess.).

² Ambrose Channel.

³ Exclusive of \$41,479.12 applied to rock off Pier A, North River.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	15,552,676	\$2,140,243,057
1914.....	15,238,057	2,056,847,222
1915.....	17,885,893	2,216,337,518

MAINTENANCE, INCLUDING AMBROSE CHANNEL AND GEDNEY AND MAIN SHIP CHANNELS.

Amount expended on all projects from July 5, 1884, to June 30, 1916:

New work	\$1, 634, 554. 52
Maintenance	1, 179, 446. 81
Total	2, 814, 001. 33

Balance available for fiscal year ending June 30, 1917 57, 455. 30

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement 40, 000. 00

AMBROSE CHANNEL—IMPROVEMENT.

Amount expended on all projects from Mar. 3, 1899, to June 30, 1916:

New work	5, 210, 358. 30
Maintenance	192, 365. 55
Total	5, 402, 723. 85

July 1, 1916, balance available 128, 515. 07

NEW YORK HARBOR, N. Y., UPPER BAY, OPPOSITE ANCHORAGE GROUNDS—
NEW PROJECT.

The following report of the board of engineers, in which the Chief of Engineers concurs, is printed in House Document 518, Sixty-third Congress, second session:

This is a report on plan and estimates of "New York Harbor, N. Y., upper bay, with a view to improving channel opposite anchorage grounds." The main anchorage grounds in upper New York Bay are located on the west side of the main channel, along the Jersey shore, and in order to provide sufficient area, these anchorages extend out into the deep water, leaving a minimum channel width of 370 feet for vessels drawing 40 feet and over and 1,000 feet for vessels drawing 30 feet. Experience with enormous traffic in this harbor indicates that this width is insufficient.

To provide the necessary unobstructed channelway, a plan of improvement is proposed for a channel 2,000 feet wide and 40 feet deep, the west side of the channel to skirt the eastern edge of the anchorage grounds. The project proposed is in effect an extension of the Ambrose Channel into and through the upper bay and may be considered as a necessary enlargement of the existing project. An estimate for the excavation of this channel with the regular New York Harbor dredges is presented in the sum of \$830,000, and the district officer and the division engineer are of opinion that the demands of navigation are sufficient to warrant the improvement at this cost. No accurate estimate for maintenance can be given, but the district officer states that it will probably not exceed \$50,000 annually, and may fall much below that sum.

The dimensions proposed for this channel correspond with those of the Ambrose Channel of entrance to New York Harbor, and it appears from experience that practically such dimensions are required to meet the constantly increasing demands of navigation, particularly during foggy weather, at which time a commodious channel is essential to insure reasonable safety.

The board concurs in the views of the district officer and the division engineer and recommends an extension of the improvement of New York Harbor and Ambrose Channel to include the work proposed above and shown on the accompanying map, at an estimated first cost of \$830,000 and such sum as may be necessary for maintenance.

HUDSON RIVER CHANNEL, NEW YORK HARBOR.

Location and description.—The Hudson River empties into the Upper Bay of New York Harbor at the Battery, New York City. The section of the river included in the project for improvement under this title extends from a line joining the Battery and Ellis Island to the northern limits of New York City, a total distance of about 16 miles. The width of the river between pierhead lines is 3,900 feet at the Battery, gradually decreasing to 2,750 feet at West Fourteenth Street, New York City, and 2,725 feet at West Fifty-ninth Street; thence widening to 5,400 feet at Spuyten Duyvil Creek, which width it maintains to the northern boundary of New York City.

Existing project.—This project (H. Doc. No. 719, 62d Cong., 2d sess.) was adopted by river and harbor act of March 4, 1913, as modified by river and harbor act of March 4, 1915 (see Annual Report for 1914, pp. 234 and 235), and provides for a channel 800 feet wide and 30 feet deep at mean low water from deep water off Ellis Island to 1,300 feet below the foot of Newark Street, Hoboken; thence to Castle Point and the removal of a shoal to a depth of 40 feet; a channel 550 feet wide and 26 feet deep along the Weehawken-Edgewater water front; the removal to a depth of 40 feet of ledge rock lying about 1,000 feet southwest of Pier A at the Battery; the removal of a shoal on the New York side, between West Nineteenth and Thirty-second Streets, to a depth of 40 feet; and the removal of an obstruction north of the mouth of Spuyten Duyvil Creek to the depth of the surrounding river bottom. Estimated cost, \$1,570,000. No estimate for maintenance is given, as the amount required can be determined only from experience. The length of the projected channel in the Jersey City-Hoboken water front is about 3 miles, and of the channel in the Weehawken-Edgewater water front about 5 miles. The total length of river included in the improvement is about 16 miles. Mean tidal range at the Battery 4.4 feet; at the mouth of Spuyten Duyvil Creek 3.7 feet. (For latest published map see Annual Report for 1915, p. 2144.)

The act of March 4, 1915, provided for the maintenance of New York Harbor and its immediately tributary waters by the collection and removal of drift, and authorized the Secretary of War to allot such amounts as may be necessary for the work from funds available for specific portions of New York Harbor and such tributaries.

Condition at the end of fiscal year.—The work done under all projects has resulted in removing rock off Pier A to 38 feet; in dredging a channel in the Jersey City water front 200 feet wide and 30 feet deep; in completing the removal of the shoal in the Hoboken water front to a depth of 40 feet; and in dredging a channel in the Weehawken-Edgewater water front 250 feet wide and 26 feet deep. The controlling depths on June 30, 1916, in the dredged channels are estimated at 30 feet in the Jersey City water front; 40 feet in the Hoboken water front, and 24 feet in the Weehawken-Edgewater water front. Up to June 30, 1916, about 36 per cent of the work proposed under the existing project had been completed, and the total expenditures thereunder amounted to \$558,740.68—\$558,623.81 for new work,

and \$116.87 for maps, etc., for which the appropriation was reimbursed by receipts from sales and collections.

To complete the project it is necessary to widen the channels in the Jersey City and Weehawken-Edgewater water fronts, to complete the removal of the rock off Pier A, to remove the shoal on the New York side, and to remove the obstruction north of Spuyten Duyvil Creek.

Local cooperation.—There are no conditions imposed by law requiring local cooperation.

Effect of improvement.—As the result of the improvement the largest trans-Atlantic steamers can now reach their piers at Hoboken, N. J., if skillfully maneuvered, and unusual activity is shown in making improvements in the Weehawken-Edgewater water front in the way of pier construction, pier extension, and in dredging in their vicinity. It is impracticable to ascertain what effect the improvement has had on freight rates.

Proposed operations.—The funds available June 30, 1916, together with those appropriated by the river and harbor act of July 27, 1916, will be expended in widening, by dredging, the channels along the Weehawken-Edgewater and the Jersey City water fronts. It is expected that this work will be commenced in the fall of 1916, and that the funds will be exhausted about August 1, 1917.

It is proposed to expend the funds, for which estimate is submitted in this report, as follows:

For dredging shoal from West Nineteenth Street to West Thirty-second Street, Manhattan	\$185, 000
For rock removal, including ledge off Pier A	22, 000
For removing obstruction north of Spuyten Duyvil Creek	3, 500
Total	210, 500

A shoal along the Manhattan water front obstructs the approach of deep-draft steamships to the piers, while the ledge off Pier A lies in the channel used by these vessels. They should therefore be removed as soon as practicable. The obstruction north of Spuyten Duyvil Creek has been the subject of numerous complaints and is a menace to navigation which should be removed.

Commercial statistics.—As the result of a careful canvass, the commerce of the section of the Hudson River included for improvement under this title consists of all classes of commercial products and manufactures, and is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.	Passengers carried.
1913.....	64,517,302	\$2,958,075,917	109,459,665
1914.....	58,644,614	4,559,185,809	106,253,639
1915.....	63,458,291	6,410,144,119	69,239,418

The tonnage is carried in vessels ranging in loaded draft from about 7 feet at all stages of the tide up to 38 feet at high water.

Amount expended on all projects from March 4, 1913, to June 30, 1916, new work-----	\$627, 719. 80
Balance available for fiscal year ending June 30, 1917-----	465, 823. 68
Amount (estimated) required to be appropriated for completion of existing project-----	545, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement-----	210, 500. 00

HUDSON RIVER CHANNEL, NEW YORK HARBOR, N. Y.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1697, Sixty-fourth Congress, second session:

The section of the harbor included under the name of Hudson River Channel extends from Ellis Island to the northern limits of New York City, a distance of about 16 miles. The width of the river within these limits varies from 2,725 to 5,400 feet. Originally the widths at various points were much greater, but they have been reduced as a result of water-front improvements and successive advances of the pierhead line to permit the lengthening of piers in keeping pace with the continuing increase in the size of trans-Atlantic steamships. A channel having a mean low-water depth of 40 feet and over and a minimum width of 1,000 feet extends throughout and some distance beyond the section covered by this examination. There are three extensive shoal areas bordering the channel in this reach, however, one off the Jersey City shore, extending from Ellis Island to Castle Point; one on the same shore, from Weehawken to above the northern limits of New York City; and the third on the New York shore, from West Nineteenth to about West Seventy-fifth Streets. Some work on each of these shoals is contemplated under the present project, including the removal of the last-named shoal from West Nineteenth Street to West Thirty-second Street. Between West Forty-fourth and West Fifty-sixth Streets the city of New York has undertaken the construction of one pier 1,000 feet long, and proposes to construct two additional long piers at this site practically in continuation of the work now in progress. In order that these piers may be available for use by trans-Atlantic steamships upon completion, the district officer believes that the shoal along this front should be removed to a depth of 40 feet at mean low water from West Thirty-second Street to West Sixty-first Street. Between the Battery and Canal Street the channel is too narrow for safe navigation by the trans-Atlantic vessels, especially in view of the enormous traffic in this section by vessels traveling in all directions. In the opinion of the district officer, giving due consideration to economy, a width of 2,000 feet for the 40-foot channel in this section should be adopted for the present. He reaches the conclusion, in which the division engineer concurs, that the locality is worthy of additional improvement at the present time to the extent indicated, at a total estimated cost of \$1,320,000.

I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of the Hudson River Channel, New York Harbor, is deemed advisable to the extent of removing the shoal along the New York water front between West Thirty-second and West Sixty-first Streets to a depth of 40 feet, and increasing to 2,000 feet the width of the 40-foot channel between the Battery and Canal Street, Manhattan Borough, at an estimated cost of \$1,320,000. The annual cost of maintenance can not be estimated at the present time, but the indications are that it will be nominal. The first appropriation should be \$600,000, and the balance should be appropriated so as to complete the work within a period of three years.

NEW YORK HARBOR, BAY RIDGE AND RED HOOK CHANNELS—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 863, Sixty-third Congress, second session:

These channels lie along the east shore of the Upper Bay, New York Harbor, and, with Buttermilk Channel, form an easterly channel along the Brooklyn water front from the Narrows to the East River. The combined length of Bay Ridge and Red Hook Channels is 4½ miles.

There are submitted herewith, for transmission to Congress, reports dated October 14 and December 15, 1913, with maps, by Col. S. W. Roessler, Corps of Engineers, on preliminary examination and survey, respectively, of New York Harbor, N. Y., with a view to securing additional width in Bay Ridge and Red Hook Channels, authorized by the river and harbor act approved March 4, 1913.

The existing project for improvement of these channels, adopted in 1899, provides for a depth of 40 feet and a width of 1,200 feet. The commerce of the locality has grown from about 850,000 tons in 1886 to about 8,500,000 tons in 1913, and much larger vessels are now in use than formerly. The district officer reports that at the lower part of Bay Ridge Channel and the upper part of Red Hook Channel the width of 1,200 feet provided under the existing project is sufficient for present and anticipated needs, but he believes that some widening at and below the bend where Bay Ridge and Red Hook Channels meet is necessary. The area of the proposed widening, as shown on accompanying map, comprises a triangle of approximately 90 acres at the junction of the two channels, the maximum additional width to be obtained being about 1,000 feet where it is most needed. The estimated cost of this work is \$920,000. In the opinion of the district officer the further improvement of the locality as proposed is worthy to be undertaken by the United States, and in this opinion the division engineer concurs.

I concur with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement of New York Harbor, N. Y., with a view to securing additional width in Bay Ridge and Red Hook Channels, is deemed advisable to the extent of dredging a triangular area of about 90 acres at the junction of said channels, as proposed by the district officer and indicated on the accompanying map, at an estimated cost of \$920,000 for first construction and about \$25,000 annually for maintenance.

NEW YORK HARBOR, N. Y., BETWEEN STATEN ISLAND AND HOFFMAN ISLAND—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 625, Sixty-fourth Congress, first session:

Hoffman Island is mainly an artificial island of about 11.5 acres, situated about 7,000 feet due south from the southeast point of Staten Island. The island belongs to the quarantine department of the port of New York, and is a receiving station for persons suspected of having contagious diseases, or who have been exposed to such diseases. Situated 4,500 feet farther south is Swinburne Island, having an area of about 1.9 acres, which is maintained by the quarantine department for the detention of actual sufferers from contagious disease. Both of these islands are west of the West Bank and can not be approached from the main channel to the east on account of the shoal water. The only approach which is now extensively used is the one from the north, but the depths in this channel are insufficient for vessels of the size best adapted to the quarantine work. The improvement desired by the quarantine authorities is a channel sufficient to accommodate vessels of 15 feet draft, or 16 feet at mean low water. The district officer, who is also the division engineer, submits estimates of cost for providing a channel of this depth and 200 feet wide to Hoffman Island, amounting to \$118,000, and for extending the channel to Swinburne Island, amounting to \$142,000, a total of \$260,000. In view of the importance of the quarantine service to the great commerce of the port of New York, he expresses the opinion that it is advisable for the United States to undertake the improvement of the locality to this extent.

I concur in the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of New York Harbor, N. Y., between Staten Island and Hoffman Island, is deemed advisable to the extent of providing a channel 200 feet wide and 16 feet deep at mean low water from bell buoy 13A to Hoffman Island, with an extension to Swinburne Island, as shown on accompanying map, at an estimated cost of \$260,000 for first construction and \$6,000 annually for maintenance.

NEW YORK HARBOR, N. Y.—REMOVAL OF CRAVEN SHOAL—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document No. 557, Sixty-fourth Congress, first session:

Craven Shoal lies in the west part of the main channel from lower New York Bay to upper New York Bay, a mile south of the Narrows and $1\frac{3}{4}$ miles above the head of Ambrose Channel. The minimum depth on the shoal is 19.6 feet. Sailing vessels and tows of barges are prohibited by law from using Ambrose Channel, but in order to avoid striking the buoys marking Craven Shoal they are practically forced to follow the same track as steamers at this point. The district officer, who is also the division engineer, submits an estimate of cost amounting to \$30,000 for removing the shoal to a depth of 30 feet, and expresses the opinion that this work is worthy of being undertaken by the United States. It seems probable that the shoal, once removed, would not form again and the cost of maintenance may be regarded as negligible.

I concur in the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of New York Harbor, N. Y., with a view to the removal of Craven Shoal, is deemed advisable to the extent of removing said shoal to a depth of 30 feet at mean low water, at an estimated cost of \$30,000. It is recommended that the work be authorized as part of the project for improving New York Harbor, including Ambrose Channel, in which case no separate appropriation will be required.

BLACK ROCK HARBOR, N. Y., TRANSFER OF FUNDS TO MAINTAIN AND WIDEN LAKE ERIE ENTRANCE TO BLACK ROCK HARBOR AND ERIE BASIN.

Statement of Col. Harry Taylor, Corps of Engineers, United States Army, before the Committee on Commerce, United States Senate, February 1, 1915:

The ACTING CHAIRMAN. Colonel, you have suggested that there are one or two additional items that you desire to suggest. Will you please state them to the committee.

Col. TAYLOR. There are two items, the first with reference to the improvement of Black Rock Harbor, N. Y. That is not in the bill at all. I would like to suggest the following amendment:

"Improving Black Rock Harbor, N. Y.: The unexpended balances of appropriations heretofore made and authorized for the improvement of Black Rock Harbor and Channel, N. Y., are hereby made available for maintenance of improvement of Lake Erie entrance to Black Rock Harbor and Erie Basin, and for widening of the channel at the bend."

The conditions are shown on this map. Black Rock Harbor includes the construction of a lock and a portion of the channel up to the foot of what appears to be Maryland Street. Above that the open entrance is known as the Erie Basin.

Senator BURTON. Where is the lock?

Col. TAYLOR. This [indicating] is the lock, outside. Black Rock Harbor ends at this point. This is the Erie entrance. We have had to complete the lock and all of the channel, and there is a considerable balance on hand.

Senator NELSON. That is where the canal comes in?

Col. TAYLOR. That is where the canal comes in?

Senator BURTON. Where is the terminus of the Government work? It is outside of this map, is it not?

Col. TAYLOR. Yes; this does not show the lock at all. It is just below.

Senator BURTON. What is the distance over which the Government makes the improvement, from the lake to the improvement of the barge canal as prosecuted by the State of New York?

Col. TAYLOR. The barge canal entrance is at Tonawanda.

Senator BURTON. The terminus of what?

Col. TAYLOR. The Black Rock Harbor improvement ends at this point, at the foot of Maryland Street. Above Maryland Street is another improvement,

known as the Lake Erie entrance to Black Rock Harbor. They come under two separate appropriations, and the main object of this amendment is to consolidate the two appropriation items and make the funds which we have on hand available for maintenance of this section [indicating] as well as the maintenance of that section. That is the object of the improvement. I would like also to call attention to the fact that, as worded, it authorizes the cutting off of that corner [indicating]. That has been found necessary for the reason that these large 600-foot boats coming down have found difficulty in making the turn. The funds which are on hand are ample to maintain all of this—to do this cutting off—and still have a considerable amount.

Senator BURTON. What would it cost to do the cutting-off work?

Col. TAYLOR. \$80,000, as estimated. Under the language of the bills as now worded, it authorizes us to make the necessary widening at the bends. That would be something that would be authorized, but under the old project it is not authorized.

Senator BURTON. This channel gives access to the barge canal, does it?

Col. TAYLOR. Yes, sir; at the harbor of Tonawanda.

Senator BURTON. But the main entrance to the barge canal is at Tonawanda?

Col. TAYLOR. Yes, sir; but all the large boats that go to Tonawanda now use this channel, and the commerce through this channel runs up into the hundreds of thousands. In a report dated October 10, 1914, the district officer states:

“The Black Rock channel (canal) and lock were opened to navigation by the large vessels 400 to 600 feet long August 17, 1914, and the use by them of the approach through ‘Lake Erie Entrance’ has demonstrated, as anticipated, that the channelway at the angle off the northerly end of the New York State break-water is inadequate for making the required turn and not practicable for the long vessels without the aid of a tug.”

“As hereinbefore stated, the Lake Erie Entrance is an essential part of the Black Rock waterway, and in view of the fact that funds on hand (and authorized but not yet appropriated \$300,000) are sufficient for the work herein proposed, in addition to completing all of the work remaining to be done on the Black Rock Harbor and Channel project, including the proposed extension of channel in Niagara River to Tonawanda (H. Doc. No. 658, 63d Cong., 2d sess.), it is recommended that this project be modified and extended to include the former “Lake Erie Entrance” to Black Rock Harbor and Erie Basin project and the additional channel excavation herein estimated at \$80,000.”

That is a new project, and it is not taken in by this bill or this amendment.

Senator BURTON. Is there any such condition as this, the ownership by the New York Central Railroad, or any other railroad, of the land accessible to that canal?

Col. TAYLOR. I do not understand you.

Senator BURTON. Do they, or do they not, own the land that is adjacent to this canal?

The ACTING CHAIRMAN. The terminal facilities, you mean?

Col. TAYLOR. Everything that goes to Tonawanda goes through this canal.

Senator BURTON. So its main use is through the channel to Tonawanda?

Col. TAYLOR. Yes, sir; entirely so.

Senator BURTON. What do you understand by this terminal that is called the Erie Basin?

Col. TAYLOR. That is in the Buffalo Harbor proper. They are going through this channel [indicating]. That is the old Erie Basin terminal.

Senator BURTON. Is that to be used for the Barge Canal, as a terminal?

Col. TAYLOR. Yes, sir; it is.

Senator BURTON. Now, what they would do would be to gather their boats there and send them out through to Tonawanda, would it?

Col. TAYLOR. Yes, sir. That [indicating] may be the entrance to the Barge Canal. There is another entrance at Tonawanda, I am sure.

Senator BURTON. Will you leave that map with us?

Col. TAYLOR. Yes, sir.

Senator BURTON. There is no reason to believe that this improvement would inure to the benefit of any particular corporation, railroad company, or other, is there?

Col. TAYLOR. No, sir; it is for the benefit of all the through traffic that goes to Tonawanda.

Senator BURTON. I see no objection to the adoption of that amendment.

HARBOR AT GREAT SODUS BAY, N. Y.

Location and description.—This is a nearly landlocked bay on the south shore of Lake Ontario, 27 miles west of Oswego Harbor, N. Y. The bay has a pier-protected entrance channel and is $2\frac{1}{2}$ miles long and one-half to $1\frac{1}{2}$ miles wide with a depth of 18 to 40 feet.

Condition at the end of fiscal year.—Work in connection with the improvement of this harbor was commenced in 1829 and it has consisted in narrowing the entrance channel from the lake by the construction of two converging breakwaters connecting at their ends with two piers 438 to 473 feet apart, extending lakeward, together with the dredging necessary to secure and maintain a channel between the piers, 150 feet wide and 15 feet deep at low water. The structures are all of the timber-crib type, 2,425 feet of the timber superstructure of the piers having been replaced with concrete. The east and west piers are 1,294 feet and 1,580 feet long and the east and west breakwaters 1,438 feet and 495 feet long, respectively. The existing project is completed. The extension of the west and east piers to their present length was completed during the fiscal years 1884 and 1886, respectively, and the dredging of the channel to the 15-foot depth was completed during the fiscal year 1890. The channel is unstable and requires annual redredging to maintain the project depth. The piers, where the timber superstructure has been replaced with concrete, are in good condition. The timber superstructure of the remainder of the piers and of the breakwaters is badly decayed. The controlling depth in the channel at the close of the fiscal year was 13 feet at low water. The total expenditures under the existing project to the end of the fiscal year were \$249,472.92, of which \$46,480 was for new work and \$202,992.92 for maintenance.

Local cooperation.—No conditions were imposed by law at the time of adoption of the project. The following work has been done for the benefit of the public with funds supplied by other sources than Congress: In 1911 the Northern Central Railroad Co. dredged a channel 500 feet long, 40 feet wide, and $14\frac{1}{2}$ feet deep across the bar in front of coal trestle, 700 cubic yards of sand being removed at a cost of \$136.26.

Effect of improvement.—The improvement has facilitated navigation by furnishing an entrance channel to the bay of a depth sufficient to accommodate vessels able to pass the present Welland Canal locks, and is reported to have a material effect in controlling freight rates in bulk commodities, such as coal, grain, ore, and lumber.

Proposed operations.—With the available funds it is proposed to redredge the entrance channel to the harbor during the season of 1916, estimated cost \$1,700; replace 428 linear feet of old, decayed superstructure on the east and west piers with concrete, estimated cost \$15,500; and make necessary repairs to dredging plant and pier-repair plant, estimated cost \$1,700. It is expected that this work of pier repair will be completed about June 30, 1917, and that the funds will be exhausted by that date.

The entrance channel requires redredging annually. The timber superstructure of the east breakwater is badly decayed and should

be rebuilt in concrete form. It is estimated that additional funds will be required for the fiscal year ending June 30, 1918, as follows:

Redredging entrance channel and care and repairs to dredging plant--- \$3, 000
 Replacing timber superstructure on 1,424 linear feet of east breakwater
 with concrete ----- 18, 500

Total ----- 21, 500

Commercial statistics.—The receipts consisted of a small quantity of feldspar and the shipments of hard and soft coal. Coal, which comprised 98.8 per cent of the total tonnage, is carried in vessels of 12 to 14 feet draft. All freight tonnage makes use of the improvement.

Comparative statement.

Calendar year.	By lake.	
	Short tons.	Value.
1913.....	65,137	\$175,803
1914.....	47,673	140,464
1915.....	51,958	151,618

Amount expended on all projects from Mar. 2 1829, to June 30, 1916:

New work----- \$408, 251. 80
 Maintenance (since 1882) ----- 202, 992. 92

Total----- 611, 244. 72

Balance available for fiscal year ending June 30, 1917----- 19, 029. 93

Amount that can be profitably expended in fiscal year ending June
 30, 1918, for maintenance of improvement----- 21, 500. 00

HARBOR AT LITTLE SODUS BAY, N. Y.

Location and description.—This is a nearly landlocked bay 13 miles west of Oswego Harbor, N. Y., 2 miles long, one-fourth to five-eighths mile wide, connected with Lake Ontario by a pier-protected entrance channel 2,300 feet long.

The existing project is to secure and maintain an entrance channel 150 feet wide and 15 feet deep at low water between parallel piers of the timber-crib type about 250 feet apart, by dredging without further extension of the piers for the present. For map see page 2470 of Annual Report for 1894.

Condition at the end of fiscal year.—The improvement was commenced in 1854 and has consisted of the following: Construction of two parallel piers 250 feet apart, east pier 1,810 feet long and west pier 1,747 feet long; construction of two breakwaters connecting the inner ends of these piers to the shore, the east and west breakwaters being 1,680 feet and 469 feet long, respectively; dredging of a channel 150 feet wide and 15 feet deep at low water. The structures are all of the timber-crib type, the piers and 457 feet of the east breakwater having concrete superstructure. The west and east piers were completed to their present lengths during the fiscal years 1886 and 1906, respectively, and the original dredging contemplated by the existing project was completed during the fiscal year 1896. The piers and the part of the east breakwater having concrete superstructure are in good condition, the timber superstructure of the remainder

being badly decayed. The controlling depth in the channel is 14½ feet. The channel is unstable and requires redredging annually. The total expenditure under the present project to the end of the fiscal year was \$282,210.43, of which \$69,066.20 was for new work and \$213,144.23 for maintenance.

Local cooperation.—No conditions were imposed by law at the time of adoption of the project. About \$6,000 was expended in 1857 by the Ontario Bay Harbor Improvement Association in dredging the channel in amplification of Government dredging.

Effect of improvement.—The project is reported to have a material effect in controlling freight rates on bulk commodities, such as coal, grain, lumber, and ore. It has facilitated navigation by providing a channel into the bay having a depth of 15 feet at low water where the original depth was only 18 inches.

Proposed operations.—With the funds available it is proposed to redredge the entrance channel during July, 1916, estimated cost \$600, make necessary repairs to the dredging and pier repair plants during the winter of 1916–17, estimated cost \$1,300, and continue rebuilding the east breakwater with concrete superstructure approximately 500 feet, estimated cost \$7,000. It is expected that the pier repair work will be suspended in September, 1916, and that the repairs to plant will be completed about April 30, 1917, when the funds will be exhausted.

Additional funds will be required for the fiscal year 1918, estimated as follows:

Redredging entrance channel, season of 1917.....	\$1, 500
Repairs to dredging and pier repair plant.....	1, 500
Replacing timber superstructure with concrete on 640 linear feet of east breakwater	9, 000
Total.....	12, 000

Commercial statistics.—The receipts consisted of vessel repair parts of small valuation and shipments of a small quantity of apples and soft coal and a larger quantity of hard coal. All commerce makes use of the improvement. Hard coal, which comprises nearly 100 per cent of the total tonnage, is carried in vessels with drafts of 12 to 14 feet.

Comparative statement.

Calendar year.	By lake.	
	Short tons.	Value.
1913.....	116, 819	\$555, 728
1914.....	133, 968	643, 773
1915.....	130, 708	632, 676

Amount expended on all projects from Aug. 30, 1852, to June 30, 1916:

New work.....	\$301, 393. 95
Maintenance (since 1882).....	213, 144. 23

Total	514, 538. 18
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July 1, 1916, balance available.....	7, 101. 84
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	12, 000. 00

WESTCHESTER CREEK, N. Y.—NEW PROJECT.

Report of the Chief of Engineers, printed in House document 370, Sixty-fourth Congress, first session:

Westchester Creek enters an estuary on the north side of East River, about 14 miles east of the Battery, New York City. The present project, adopted by the river and harbor act of June 25, 1910, provides for a channel 8 feet deep at mean low water and 100 feet wide across the estuary; thence 80 feet wide to about 1,000 feet above Scrivens Wharf; and thence 60 feet wide to the head of navigation, at an estimated cost of \$91,280. The project is practically completed. The commerce has increased from about 50,000 tons in 1891 to 169,164 tons in 1912, and 589,322 tons in 1914. The existing navigation facilities appear to be inadequate for the proper handling of the vessels engaged in traffic on this stream. The district officer, who is also the division engineer, estimates that to increase the depth to 10 feet and the width to 150 feet, as specified in the river and harbor act of March 4, 1913, will cost \$375,000. He deems this expenditure larger than resulting benefits would warrant, but believes the locality is worthy of further improvement to the extent of providing a channel 10 feet deep, 125 feet wide at Unionport and Westchester, and 100 feet wide elsewhere, at an estimated cost of \$291,000 for construction and \$1,500 annually for maintenance.

The Board of Engineers for Rivers and Harbors concurs in general with the views of the district officer, but believes that a width of 100 feet throughout will fairly well serve the needs of commerce, and that any additional width required in order to reach the wharves at Unionport and Westchester should be provided by the interests concerned. The estimated cost of the project as thus modified is \$208,000.

I concur in general with the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of Westchester Creek, N. Y., is deemed advisable to the extent of providing a channel 10 feet deep at mean low water and 100 feet wide, from East River to the Fort Schuyler Road at Westchester, at an estimated cost of \$208,000 for first construction and \$1,500 annually for maintenance, subject to the condition that the necessary right of way across upland lying between the harbor lines as established by the Secretary of War May 2, 1914, shall be furnished free of cost to the United States before work is begun under the new project.

EAST CHESTER CREEK, N. Y.

Location and description.—This creek, also known as Hutchinson River, empties into East Chester Bay, an indentation in the north shore of Long Island Sound immediately east of Throgs Neck, about 12 miles west of the Connecticut State line and about 21 miles, by water, east of the Battery, New York City. The navigable section of the creek, 100 feet to 1,000 feet in width, extends about $2\frac{1}{2}$ miles above its mouth. The bay is about 3 miles long and 1,000 feet to $1\frac{1}{2}$ miles wide. The approach to the creek is approximately 600 feet wide, with a controlling depth of 5 feet at mean low water.

Condition at the end of fiscal year.—The work done under all projects resulted in completing in 1899 a channel 100 feet wide and 9 feet deep at mean high water to a point about 3,000 feet above the bridge at Boston Post Road; in the construction in 1877 of 993 linear feet of pile dike and $242\frac{1}{2}$ feet of crib dike along the east bank of the dredged channel immediately below the bridge; and in making a channel of navigable width and 5 feet depth at mean low water from the mouth of the creek to Fulton Avenue Bridge, near the head of navigation, except for short stretches just below Goose Island and about 1,000 feet below Boston Post Road. The controlling depth is now 4 feet at mean low water up to the Fulton Avenue Bridge;

above this the depth is 1 foot and less. Up to June 30, 1916, about 81 per cent of the work proposed under the existing project had been completed, and the total expenditures thereunder amounted to \$86,928.05—\$83,243.12 for new work and \$3,654.22 for maintenance.

To complete the project the following work remains to be done: Widening of the channel by dredging and rock removal for short stretches near the mouth and about 1,800 feet below the bridge at Boston Post Road, dredging about 700 feet of channel in the vicinity of Goose Island and 600 feet about one-fourth of a mile below Boston Post Road, and dredging the channel at and above the bridge at Fulton Avenue.

Local cooperation.—There were no conditions imposed by law requiring local cooperation. In 1877 the lands necessary for a right of way were secured to the United States by the State of New York. This right of way extended from a point some distance below the Boston Post Road up to a point about 3,000 feet above this road. In 1894 a slip and basin were excavated and bulkheaded in the west shore of the creek, immediately above the Boston Post Road, at a cost of about \$50,000.

Effect of improvement.—As the result of the improvement there has been an appreciable increase in the loaded draft of vessels using the creek, and navigation has been made safer in the rock sections. The financial benefits to the locality are indicated by the amount saved through the use of water instead of rail transportation for coal, cement, crushed stone, and flagging. This saving amounted to about \$149,900 in 1915.

Proposed operations.—The funds available June 30, 1916, together with those appropriated by the river and harbor act of July 27, 1916, will be expended for dredging at and above Fulton Avenue Bridge and in the vicinity of Goose Island and for removing scattering points of rock below Pelham Highway Bridge. It is expected that this work will be commenced in the fall of 1916, and the available funds exhausted by May 1, 1917.

The navigable depth of the creek is controlled by the depth over several shoals between Boston Post Road and the mouth of the creek. About 1,800 feet below Boston Post Road is a small rock ledge which forces boats to use the east side of the channel. These conditions should be remedied. The funds for which estimate is submitted in this report will be expended for this purpose as follows:

Dredging at several points between Boston Post Road and the mouth—	\$9,000
Rock removal below Boston Post Road—	2,000
Total	11,000

Commercial statistics.—As the result of a careful canvass, it appears that the tonnage and value of the commerce of this locality, mainly in building materials, coal, and oil and products, are as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	194,956	\$1,158,279
1914.....	135,065	857,827
1915.....	139,798	776,331

Passengers carried, none.

Amount expended on all projects from Mar. 3, 1873, to June 30, 1916:

New work-----	\$172,365.05
Maintenance-----	30,065.00
Total-----	202,430.05

Balance available for fiscal year ending June 30, 1917-----	7,616.95
Amount (estimated) required to be appropriated for completion of existing project-----	11,654.22
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement-----	11,000.00

EAST RIVER, N. Y.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 188, Sixty-third Congress, first session:

The East River forms the eastern entrance to New York Harbor through the waters of Long Island Sound. The existing project for its improvement, adopted in 1868, provides for the removal of certain obstructions to a depth of 26 feet below mean low water. The removal of additional obstructions has been added to this project from time to time, but no change in the project depth has been made, notwithstanding the great increase in size and draft of vessels since the project was adopted. The district officer is of opinion that a depth of 35 feet in the through channel is now required to meet the needs of navigation, and he presents a plan providing for this depth and a width of 900 feet, excepting in the reach west of Blackwells Island and in the short reaches opposite Negro Point and the Sunken Meadows, where the width would be restricted to about 600 feet. The estimated cost of this work is \$10,504,500. In addition to the through channel, the district officer is of opinion that certain work should be done to give access to the wharves, and other work should be undertaken to diminish the tidal velocities through Hell Gate. The work required to give access to the wharves involves the removal of a number of shoals and isolated rocks and is estimated to cost \$10,451,337. The work recommended primarily for the purpose of reducing tidal velocities consists in the excavation of a channel in Harlem Kills, 480 feet wide and 24 feet deep, at an estimated cost of \$4,833,257, and a channel in Little Hell Gate 600 feet wide and 24 feet deep, at an estimated cost of \$6,148,629. The plan also contemplates the completion of a channel 400 feet wide and 26 feet deep between North and South Brother Islands and the construction of a channel 300 feet wide and 20 feet deep south of South Brother Island, estimated to cost \$215,000 and \$380,778, respectively. The total cost of the project proposed by the district officer is \$32,533,501. In view of the existing and future commerce of the port of New York and of the urgent need of a fuller utilization of the whole of its water front, he is of opinion that the East River is worthy of further improvement to the extent indicated above.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to the board's accompanying report, dated July 16, 1913. Not being convinced that all the work recommended by the district officer would be justified at present, the board requested that certain revised estimates be secured. The board is not satisfied that the large expenditure proposed for current regulation would result in commensurate benefits, and as the problem of tidal changes at this locality is complex, it believes that it would be better to await the developments that may follow the construction of the Harlem Kills Channel to a depth of 18 feet, which has been recommended by the department but not yet adopted by Congress. The estimated cost of the work recommended by the board for the through 35-foot channel is \$8,616,780; for the work required to give access to the wharves, \$2,129,458; for channel east of Blackwells Island, \$1,877,000; and for other auxiliary work, \$775,281, making a total of \$13,389,519, or, in round numbers, \$13,400,000.

I concur in general with the views of the Board of Engineers for Rivers and Harbors, and therefore in carrying out the instructions of Congress, I report that the further improvement of East River, N. Y., is advisable to the extent contemplated by the revised project recommended by the board at an estimated cost of \$13,400,000. The improvements once made will be practically permanent.

NEWTOWN CREEK, N. Y.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 936, Sixty-fourth Congress, first session:

Newtown Creek empties into East River at a point opposite Thirty-fourth Street, New York City. Dutch Kills, Maspeth Creek, and English Kills are short tributaries of Newtown Creek. The existing project, adopted by the act of June 3, 1896, provides for dredging a channel 18 feet deep at mean low water and 125 feet wide from the mouth to the head of navigation at the intersection of Metropolitan Avenue and Newtown Creek, or East Branch, and to the Metropolitan Avenue Bridge crossing English Kills, or West Branch. The project has been completed. To June 30, 1915, there had been expended on this and previous projects \$496,662.55. The mean range of tide is about $4\frac{1}{2}$ feet. The district officer states that the only unusual difficulties of navigation are due to the density of the traffic and the narrowness of the stream. The deepest draft vessels now using the creek in considerable numbers are the lumber schooners and barges, many of which draw 19 feet when fully loaded. At present such vessels are obliged to operate at or near high tide, at which time the channel is also used by scows destined for the tributary waters where the low-water depths are not sufficient to accommodate them. The commerce of the creek is large and valuable, averaging in recent years about 5,000,000 tons, valued at about \$200,000,000. In his report on the survey the district officer, who is also the division engineer, presents a comprehensive plan for further improvement of Newtown Creek and its tributary channels, with alternative estimates of cost for depths of 16, 18, and 20 feet, with an allowance of 2 feet for overdepth dredging in each case. He is of opinion that the locality is worthy of further improvement to the extent of providing a channel 20 feet deep at mean low water, 250 feet wide at the entrance, narrowing to 150 feet, and continuing with this width to Grand Street Bridge on the East Branch, and thence 125 feet wide to Metropolitan Avenue on said branch, including the removal of Mussel Island; 150 feet wide in English Kills, or West Branch, to the Metropolitan Avenue Bridge across said branch, including the easing of bends; 100 feet wide for a distance of 2,000 feet up Maspeth Creek, and 75 to 100 feet wide for a distance of 2,800 feet up Dutch Kills, with a turning basin at the head, all at an estimated cost of \$510,000, and \$18,000 annually for maintenance. He believes that the locality is worthy of further improvement to the extent indicated, subject to the condition that no work shall be done in Maspeth Creek until its harbor lines have been approved by the Secretary of War and all questions of right of way have been satisfactorily settled without expense to the United States; and that no work shall be done on removal of Mussel Island or on widening the channel above that island or in English Kills until the necessary rights of way have been provided in each case without cost to the United States and corresponding changes have been made in the existing harbor lines.

I concur in the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of Newtown Creek, N. Y., including Dutch Kills, Maspeth Creek, and English Kills, is deemed advisable to the extent of providing a depth of 20 feet at mean low water, with the widths recommended by the district officer as described above and shown approximately on accompanying map, at a total estimated cost of \$510,000, subject to the conditions recommended by the district officer and the Board of Engineers for Rivers and Harbors and specified above.

HARLEM RIVER, N. Y.

Location and description.—The Harlem River and Spuyten Duyvil Creek, both included in the project for improvement, are two tidal waterways of a joint length of about 8 miles which join at Kingsbridge. They lie wholly within the limits of Greater New York, and separate Manhattan Island from the mainland. The East River entrance is about $8\frac{1}{2}$ miles northeast of the Battery, New York City, and the Hudson River entrance about $13\frac{1}{2}$ miles north of the Battery. The Harlem River also connects with the East River by way of Little Hell Gate, between Wards and Randalls Islands, and by way of

Harlem (Bronx) Kills, between Randalls Island and the mainland. These channels are not used by navigators, being shoal, rocky, and winding, with strong tidal currents.

Existing project.—The existing project (H. Doc. No. 75, pt. 9, 43d Cong., 2d sess.) was adopted June 18, 1878. It was modified in 1879, October 7, 1886, and October 2, 1893 (Annual Reports for 1887, p. 671; 1888, p. 598; and 1894, pp. 789 and 790), and was enlarged by act of March 4, 1913 (H. Doc. No. 557, 62d Cong., 2d sess.). As modified and enlarged, it provides for a continuous channel 400 feet wide and 15 feet deep at mean low water from the East River to the Hudson River, except at Washington Bridge, where the adopted width is 354 feet, and at the rock cut through Dyckmans Meadow where the adopted width is 350 feet and the depth 18 feet. It also provides for straightening the channel at Johnson Iron Works by making a cut at this point 400 feet wide and 15 feet deep at mean low water; estimated cost, \$3,550,000.

The mean tidal range as determined in 1907 is as follows: Mill Rock, 5 feet; Spuyten Duyvil Bridge, 3.7 feet. The total length of the waterway is about 8 miles. (For latest map, see p. 656 of Annual Report for 1882 and H. Doc. No. 557, 62d Cong., 2d sess.)

The act of March 4, 1915, provided for the maintenance of New York Harbor and its immediately tributary waters by the collection and removal of drift and authorized the Secretary of War to allot such amounts as may be necessary for the work from funds available for specific portions of New York Harbor and such tributaries.

Condition at the end of fiscal year.—About 61 per cent of the work proposed under the existing project has been completed. The work done under all projects has resulted in making a channel 15 feet deep at mean low water and 400 feet wide from the East River to Putnam Railroad Bridge except at a few points where the channel is somewhat narrowed by shoals, and at Macombs Dam Bridge, where the available depth is 12 feet in the westerly draw opening; the easterly one is not navigable, being obstructed by ledge rock (now in process of removal). From the Putnam Railroad Bridge to the Hudson River the channel is 15 feet deep and from about 150 feet to 350 feet wide. On June 30, 1916, the maximum available depth for navigation through the Harlem River is estimated at 15 feet at mean low water, except at Macombs Dam Bridge, where it is not more than 12 feet. The widths of channels through bridge draws are 98 to 100 feet. At High Bridge the piers obstruct navigation and cause eddies and high current velocities which render navigation through the bridge channel hazardous; the horizontal clearance normal to the channel between these piers at elevation -5 , mean low-water reference, is but about 44 feet. The expenditures under this project to June 30, 1916, amount to \$2,022,837.19—\$1,980,115.08 for new work, \$37,258.59 for maintenance, \$963.52 for maps, etc., for which the appropriation was reimbursed by receipts from sales and collections, and \$4,500 was recovered on the bond of a failing contractor and credited to the appropriation.

To complete the improvement there remains to be done a considerable amount of dredging and rock excavation in several stretches of the river between Madison Avenue Bridge and the Hudson River.

Local cooperation.—The river and harbor act of June 18, 1878, adopting the existing project for this improvement, and the river

and harbor act of March 3, 1879, provided that the necessary right of way should be provided free of cost to the United States before work was begun. This provision was complied with by the State of New York, which procured the necessary lands and completed their transfer to the United States in May, 1887. A similar provision is contained in the river and harbor act of March 4, 1913, authorizing the straightening of the channel at Johnson Iron Works. The river and harbor act of March 4, 1915, provides for the cession to the State of the land occupied by the present channel at that point after the right of way for the cut-off had been provided and the new channel completed. A description of the lands required, with map, has been furnished the State of New York. The prosecution of the work of straightening the channel is awaiting the transfer of these lands.

Effect of improvement.—The opening of the Harlem River to navigation has resulted in greatly increasing the areas of Manhattan and Bronx Boroughs to which heavy freight can be brought by water with a marked saving in cost.

Proposed operations.—The funds available June 30, 1916, together with those appropriated by the river and harbor act of July 27, 1916, will be expended for rock removal in the easterly draw channel at Macombs Dam Bridge and for dredging and rock removal from Putnam Bridge to the vicinity of High Bridge. Work at Macombs Dam Bridge is now under way and should be completed in the spring of 1917. It is expected that work above Putnam Bridge will be commenced in the fall of 1916 and that the available funds will be exhausted about June 30, 1917.

It is proposed to expend the funds for which estimate is submitted in this report in continuing the improvement as follows:

For rock removal at Macombs Dam Bridge and in the vicinity of High Bridge.....	\$125,000
For dredging above High Bridge.....	125,000
	<hr/>
	250,000

Ledge rock now obstructs the west draw channel of Macombs Dam Bridge at a depth of 12 feet. This should be deepened to project depth as soon as the work now under way in the east channel is completed. The removal of the rock ledge in the west side of the channel at High Bridge is necessary to assist in relieving the constriction of the channel at this point. The dredging proposed is for the purpose of continuing the channel of project dimensions to above the mouth of Sherman Creek, at which point a State barge canal terminal is to be located.

Commercial statistics.—As the result of a careful canvass the commerce of the Harlem River, mainly in general merchandise, coal, building materials, grain, etc., and ice, appears to be as follows:

Comparative statement.

Calendar year.	Short tons	Value.	Passengers carried. ¹
1913.....	18,213,326	\$704,984,490	.....
1914.....	11,577,922	522,383,737	.....
1915.....	15,096,169	1,538,505,523	454,199

¹ None reported in 1913 or 1914 returns.

The reduction in the amount of commerce carried on the Harlem River in 1914 below that of previous years is due mainly to removal of a large lumber yard to the East River and an unexplained reduction in the coal tonnage.

Amount expended on all projects from June 18, 1878, to June 30, 1916:

New work-----	\$2, 006, 578. 60
Maintenance -----	37, 258. 59
Total-----	2, 043, 837. 19
Balance available for fiscal year ending June 30, 1917-----	274, 191. 47
Amount (estimated) required to be appropriated for completion of existing project-----	1, 290, 258. 59
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement-----	250, 000. 00

RARITAN BAY, N. J.

Location and description.—Raritan Bay lies between the southern end of Staten Island and the New Jersey shore, with lower New York Bay on the east. Its greatest width, north and south, is about 5 miles, and its greatest length, east and west, is about 7 miles. The Raritan River flows into its west end between Perth Amboy and South Amboy, and the Arthur Kill or Staten Island Sound extends northward from this point to Newark Bay.

Existing project.—The original and existing project was adopted by the river and harbor act of March 3, 1881. (See H. Doc. No. 45, 46th Cong., 3d sess.) It was subsequently modified and extended in 1884–85 (see Annual Report for 1885, pt. 1, p. 757); the project was again extended September 19, 1890 (see Annual Report for 1891, p. 933), and again on June 3, 1896 (H. Doc. No. 298, 53d Cong., 3d sess.). The original estimate of the cost was \$126,500. This was subsequently increased to \$507,875 for the improvement, with \$20,000 annually for maintenance. The project, as modified, provides for dredging channels 300 feet wide and 21 feet deep, mean low water, from Seguine Point to deep water in the bay, a distance of about 1.5 miles; through two shoals opposite Wards Point, originally aggregating 1 mile in length, and subsequently extended toward Seguine Point to a length of 2 $\frac{2}{3}$ miles; from South Amboy to deep water near Great Beds Light, a distance of 1.5 miles. The mean range of tides is 5 feet. The latest published map is printed in appendix to Annual Report for 1911, page 1330.

Condition at the end of fiscal year.—The channel dimensions as projected have been made, the last work for carrying out the improvement being done in 1905, but shoaling has narrowed the available widths of the same. Dredging for maintenance has been done. The maximum draft that could be carried June 30, 1916, through the improved channels was 19 to 21 feet at mean low water. The total amounts expended up to June 30, 1916, were: For the carrying out of the improvement, \$388,676.40; for maintenance, \$279,415.43; total, \$668,091.83.

Effect of improvement.—It appears from statements of the shipping interests of the great railroad terminals that the improvements have resulted in a reduction of towing rates and a proportionate reduction of freight rates, owing to the greater quantity of freight

that can be carried and towed through these channels over that which was carried before the improvement was made.

Proposed operations.—It is proposed to expend the balance of funds available June 30, 1916 (\$4,368.04), in connection with existing contract for maintenance of the Seguine Point and Wards Point Channels. The funds appropriated by the act of July 27, 1916 (\$20,000), will be expended in maintenance of the Seguine Point and Wards Point Channels, also a part of the South Amboy Channel should deterioration make it urgent and funds will be available for the purpose. The funds appropriated will be used at the rate of about \$6,000 per month and will be exhausted by June 30, 1917.

It is proposed to expend the funds to be furnished under the estimate in this report in dredging for maintenance in all three channels. The deterioration in those channels is more rapid than was anticipated, and on this account the sum herein estimated far exceeds the annual sum for maintenance contemplated by the project.

Commercial statistics.—The commerce of this bay is mainly coal, brick, refined lead and copper, bullion, clay products, and general merchandise.

Comparative statement.

Year.	Short tons.	Value.
1913.....	10,500,337	\$152,691,821
1914.....	9,751,484	137,264,383
1915.....	10,137,890	137,298,379

Amount expended on all projects from Mar. 3, 1881, to June 30, 1916:

New work.....	\$388,676.40
Maintenance.....	279,415.43

Total.....	668,091.83
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Balance available for fiscal year ending June 30, 1917.....	24,368.04
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	40,000.00
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ABSECON INLET, N. J.

Location and description.—This inlet separates Atlantic City from Brigantine Beach, and is about 65 miles north of Delaware Breakwater. The inlet is about 1 mile long.

Existing project.—This project was adopted by the river and harbor act of July 25, 1912, and is based upon report printed in House Document No. 1395, Sixty-first Congress, third session. It provides for obtaining and maintaining, by dredging, for a period of five years, a channel through the inlet 12 feet deep at mean low water and 300 feet wide, the question of continuing the improvement to be then determined in the light of the commerce that may be developed. In adopting the project it was stipulated that the work should be done by contract, if suitable dredges were available, otherwise by Government plant. The estimated first cost is \$270,000, and \$50,000 annually for operating expenses. The mean range of tide at this locality is about 4 feet, and the length of channel included in the project about 1 mile.

Condition at the end of fiscal year.—A channel not less than 12 feet deep and 300 feet wide had been secured at the close of the fiscal year. The total expenditure under the existing project to the close of the fiscal year was \$250,896.89, of which \$226,496.89 was for new work and \$24,400 was for maintenance.

Local cooperation.—Authorities of Atlantic City voluntarily undertook some experimental work of harrowing the crest of the bar with a view of deepening the channel, but without any definite results.

Effect of improvement.—The inlet is now open to navigation, with a depth of not less than 12 feet and a width of not less than 300 feet, the project dimensions.

Proposed operations.—It is proposed to apply the balance available and funds estimated for in operating the dredge *Absecon* on the work of maintaining the 12-foot mean low-water channel 300 feet wide.

Commercial statistics.—The general character of the commerce for the current year was fish, oysters, clams, chemicals, horses, wagons, coal, machinery, farm produce, and general merchandise.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913 (improvement not begun).....		
1914.....	13,414	\$543,323.00
1915.....	5,237	3,025,105.67

Amount expended on all projects from July 25, 1912, to June 30, 1916:		
New work.....		\$226,496.89
Maintenance.....		24,400.00
Total.....		250,896.89
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....		
		45,000.00

WOODBIDGE CREEK, N. J.

Location and description.—This creek is a small, crooked tidal stream about 5 miles long, rising near Rahway and flowing southwardly and eastwardly through flat marshes into the west side of Arthur Kill or Staten Island Sound, 2 miles north of Perth Amboy, N. J. It is navigable to the second highway bridge, 2 $\frac{3}{8}$ miles above the mouth. The project extends from the mouth to Salamander's dock, 1 $\frac{7}{8}$ miles.

Existing project.—The second and existing project was adopted by the river and harbor act of June 13, 1902, in accordance with plan submitted in House Document No. 282, Fifty-sixth Congress, first session (which contains latest published map), and in Annual Report for 1900, page 1552. It calls for a deeper channel with slightly narrower widths than the original project, without provision for construction of dikes. It provides for dredging a channel from the Arthur Kill to the Salamander dock, a distance of about 9,600 feet, 8 feet in depth, mean low water, and 50 feet wide on the bottom and

75 feet on top. The tidal variation is about 5 feet. The estimated cost of the improvement, exclusive of amounts expended on the previous project, was \$35,000 and \$3,000 annually for maintenance.

Condition at the end of fiscal year.—Under the project of 1879 there was built 516 feet of timber dike and a channel was dredged 12 feet deep at mean high water, 50 feet wide to Cutter's dock, 2,800 feet, thence 25 feet wide to Valentine's dock, 800 feet. The existing project of 1902 was completed as projected in 1908, but funds appropriated for maintenance have been insufficient to maintain the projected dimensions. The maximum low-water draft that could be carried June 30, 1916, was 8 feet to Valentine's dock and 2 to 3 feet for the balance of projected distance. The widths were 50 feet and less. The total expenditures under the existing project to June 30, 1916, were, for carrying out the improvement, \$49,822.70; for maintenance, \$44,930.99; total, \$94,753.69.

Effect of improvement.—It appears from inquiry that freight rates have been reduced as a result of this improvement.

Proposed operations.—The funds appropriated by act of July 27, 1916 (\$3,000), will be expended in maintaining the section of the creek from its junction with the Arthur Kill to Valentine's dock, a distance of about 8,000 feet. When work is being actively prosecuted these funds will be used at the rate of about \$1,000 per month, and will be exhausted by June 30, 1917.

It is proposed to expend the funds to be furnished under the estimate submitted in this report in dredging for maintenance in that section of the creek where experience shows constant deterioration takes place, namely, from Arthur Kill to Valentine's dock.

Commercial statistics.—The commerce of this creek is mainly in clay, brick, tile, coal, tin scrap, steel scrap, and building materials.

Comparative statement.

Year.	Short tons.	Value.
1913.....	187,051	\$747,829
1914.....	59,029	583,374
1915.....	67,610	305,740

Amount expended on all projects from March 3, 1879, to June 30,

1916:

New work	\$49,822.70
Maintenance	44,930.99
Total	94,753.69

Balance available for fiscal year ending June 30, 1917..... 3,000.00

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 3,000.00

KEYPORT HARBOR, N. J.

Location and description.—Keyport Harbor is situated at the mouth of Matawan Creek, on the south side of Raritan Bay, 5 miles east of the mouth of Raritan River, and about 9 miles west of Sandy Hook, and consists of a bay 1 mile broad. It is sheltered on the east by Conashonk Point, and on the west by Matawan Point. The distance by water to New York City is about 25 miles; to Perth Amboy 5 miles.

Existing project.—The original and existing project was adopted by the river and harbor act of August 2, 1882. It provides for dredging a channel about 1 mile long from Raritan Bay to the steamboat dock at Keyport, the width to be 200 feet and the depth to be 8 feet at mean low water. The mean range of tides is 4.9 feet. The original estimate of the cost made in 1872 was \$30,475. This estimate was increased in 1883 to \$40,475, in order to provide for additional shealing. (See H. Doc. No. 153, 42d Cong., 3d sess., and Annual Report for 1873, p. 941.) The latest published map is printed in Annual Report for 1905, page 1040.

Condition at the end of fiscal year.—The project was completed in 1911. The maximum draft that could be carried June 30, 1916, to the Keyport wharves was about 8 feet at mean low water in a channel of about half the projected width. There has been expended to June 30, 1916, for carrying out the project, \$40,475; for maintenance, \$70,994.93; total, \$111,469.93.

Local cooperation.—There were no special conditions imposed by law relative to the carrying out of the project as adopted by the United States. The improvement was made without local cooperation. A channel 6 feet deep and 100 feet wide had been dredged at private expense in 1867, but this channel had shoaled to its original condition at the time of the adoption of the project. The amount expended on this work is not known.

Effect of improvement.—The effect of this improvement has been to greatly reduce freight rates, especially in the marketing of farm products.

Proposed operations.—It is proposed to expend the balance available June 30, 1916 (\$1,583.34), and funds to be allotted under act of July 27, 1916 (\$5,000) in dredging for maintenance over the entire length of the channel. When work is being actively prosecuted these funds will be used at the rate of about \$1,200 per month, and will be exhausted in about nine months.

It is proposed to expend the funds to be furnished under the estimate submitted in this report in dredging for maintenance over the entire length of the channel, experience proving that deterioration is constant.

Commercial statistics.—The commerce of this harbor is mainly in farm products, fertilizer, coal, lumber, shellfish, and miscellaneous freight, including the tonnage of Matawan Creek.

Comparative statement.

Year.	Short tons.	Value.
1913.....	130,921	\$2,057,245.20
1914.....	116,628	3,262,358.00
1915.....	59,790	1,855,003.00

Amount expended on all projects from Aug. 2, 1882, to June 30, 1916:

New work.....	\$40,475.00
Maintenance.....	70,994.93
Total.....	111,469.93

Balance available for fiscal year ending June 30, 1917.....	6,583.34
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	5,000.00

SHREWSBURY RIVER, N. J.

Location and description.—This river is a large tidal basin in the eastern part of New Jersey, and consists of two bays, each having an area of about 3 square miles, and known, respectively, as the North Branch (or Navesink River), which rises near Freehold, flows easterly, and is about 15 miles long; the South Branch, about 7 to 8 miles long, which flows in a northerly direction; and a channel called the Main Stem, which unites the two branches near Normandie and extends northerly $2\frac{3}{4}$ miles to the outlet at the southeast end of Sandy Hook Bay, which is about 4 miles south from the point of Sandy Hook. The total drainage area is about 250 square miles. The part of the river which has been under improvement by the United States consists of the Main Stem, $2\frac{3}{4}$ miles; the North Branch to Oceanic, 5 miles from the mouth; and the South Branch to the vicinity of Sea Bright, about $5\frac{1}{2}$ miles from the mouth.

Existing project.—The second and existing project was adopted by the river and harbor act of March 3, 1879, with subsequent modifications made in 1883 and 1887. It provided for the construction of training dikes and greatly extended the scope of the original project, which only provided for dredging a 6-foot channel through bars in vicinity of Navesink Lights and near Lower Rocky Point. The existing project as modified provides for the following channels to be obtained by diking and dredging 6 feet deep at mean low water 300 feet wide in the Main Stem, $2\frac{3}{4}$ miles long; 150 feet wide in the North Branch to Oceanic, $2\frac{1}{4}$ miles; 150 feet wide in the South Branch, $\frac{1}{2}$ miles, to the vicinity of Sea Bright. The mean range of tides on the outer bar is 5 feet; at Highlands Bridge, 3 feet; at Sea Bright, 1.3 feet; and at Oceanic, 2.5 feet. The original approved estimate of the cost was \$142,086. This estimate was increased by the modifications made in 1883 and 1887 to \$234,062. The approved estimate for annual maintenance is \$10,000. These estimates are exclusive of amounts expended under the previous project. References: House Document No. 38, Forty-fifth Congress, third session, and Annual Report of the Chief of Engineers for 1879, part 1, page 409. A detailed description of the project is found in the Annual Report of the Chief of Engineers for 1910, part 1, page 209. The latest published map is printed in House Document No. 1296, Sixty-second Congress, third session.

Condition at the end of fiscal year.—The project has been completed. Channels of project depths have been dredged and nine dikes have been built, aggregating 13,667 linear feet. The dredging work for improvement was completed in 1905; the last dikes were built in 1891. The maximum draft that could be carried July 1, 1916, throughout the limits of the improvement was 6 feet at mean low water. The channels had projected depth, but were narrow in many places. The amount expended under the existing project to June 30, 1916, for carrying out the project was \$200,393.95 (including \$5,000 for survey), and for maintenance, \$228,373.65, making a total of \$428,767.60.

Local cooperation.—Dredging in the channel has been done at various times by the local steamboat companies. The available information does not give the amount or cost of this work.

Effect of improvement.—It appears from reports received from the Merchants Steamboat Co. and the New York & Long Branch Steamboat Co. (Patten Line) that freight rates have been lowered and maintained as results of the improvement by the United States; also that the commerce has increased and that the improvement tends to keep the freight rates down.

Proposed operations.—The funds available June 30, 1916 (\$7,088.43), will be expended in maintenance dredging in the mouth of the river and in the protection of the Sandy Hook Neck. The funds appropriated by the act of July 27, 1916 (\$10,000), will be expended in maintenance dredging in the various sections of the river where necessary. When work is being actively prosecuted these funds will be used at the rate of about \$3,000 per month, and will be exhausted by June 30, 1917.

It is proposed to expend the funds to be furnished under the estimate submitted in this report in dredging for maintenance where required. Experience indicates that dredging will be required every year or so at the mouth and at the Highlands Bridge in the Main Stem; in Reeves Channel near the junction of the two branches; in the vicinity of Sea Bright in the South Branch; and in the upper and lower crossovers in the North Branch.

Commercial statistics.—The commerce of the river is mainly in coal, farm products, building materials, and general merchandise. The passenger traffic is important, the number of people carried by the Patten Line, in South Branch, and the Merchants line, in the North Branch, for the calendar year of 1915 being approximately 305,732.

Comparative statement.

Year.	Short tons.	Value.
1913.....	(1)	(1)
1914.....	411,635	\$8,684,723
1915.....	141,012	3,993,348

¹ Not reported.

Amount expended on all projects, Aug. 30, 1852, to June 30, 1916:

New work.....	\$220,893.95
Maintenance.....	228,373.65

Total.....	449,267.60
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Balance available for fiscal year ending June 30, 1917.....	17,088.43
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....

10,000.00

COOPER RIVER, N. J.

Location and description.—This river rises in Camden County, N. J., flows northwesterly through the northern part of the city of Camden, and empties into the Delaware River. The drainage area is 44 square miles of comparatively flat country. The navigable portion of the stream is about 9 miles. The high water widths are 220 feet and 100 feet, respectively, at the mouth and at the head of navigation; the low water widths are 160 feet and 60 feet, respectively, at the same localities.

Existing project.—This project (adopted by the river and harbor act of June 3, 1896) is for a channel 18 feet deep at mean high water (12 feet at mean low water) and 70 feet wide through the bar outside the mouth and upstream to what was formerly Browning's Chemical Works, $1\frac{1}{2}$ miles above the mouth, at an estimated cost of \$35,000. (H. Doc. No. 176, 53d Cong., 3d sess., reprinted in Annual Report for 1895, p. 1102 et seq.) The mean range of tide at the mouth is 6 feet; at Kaighns Avenue, 5 feet; and at Stoy's Landing, 2 feet. A length of 9,000 feet from the Delaware River is included in the project.

Condition at the end of fiscal year.—About 90 per cent of the project has been completed. The remaining portion, 400 feet at the upper end of the project, is unimportant. The minimum usable depth June 30, 1916, from the Delaware River to the Camden Iron Works was 9 feet at mean low water; thence to the upper end of the section covered by the project $6\frac{1}{2}$ feet. The total expenditures under the existing project to June 30, 1916, were \$28,101.64 for original work and \$34,389.24 for maintenance, a total of \$62,490.88.

Effect of improvement.—Freight rates have been reduced because the enlargement of the channel has resulted in a reduction of lighterage.

Proposed operations.—It is proposed to apply the funds available for the fiscal year ending June 30, 1917, in removing the shoaling in the river between the mouth and the Camden Iron Works, but it will now be insufficient to restore the channel to project dimensions throughout the entire length, and it is proposed to apply the funds estimated for the fiscal year ending June 30, 1918, in continuing the work of restoration. Experience has shown that the annual shoaling amounts to about 16,000 cubic yards, but the unit price of the work is high, due to the length of haul to a dumping place. No work of maintenance has been done on this river since 1914.

Commercial statistics.—The general character of commerce for the current year was coal, ores, pipe, hay, manure, oil, chemicals, skins, building materials, and miscellaneous merchandise.

Comparative statement.

Year.	Short tons.	Value.
1913.....	289,061	\$3,699,277.26
1914.....	291,305	3,386,414.51
1915.....	237,099	3,415,845.00

Amount expended on all projects from June 3, 1896, to June 30, 1916:

New work.....	\$28,101.64
Maintenance	34,389.24
Total.....	62,490.88

Balance available for fiscal year ending June 30, 1917.....	5,009.12
Amount (estimated) required to be appropriated for completion of existing project.....	6,827.94
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	5,000.00

WOODBURY CREEK, N. J.

Location and description.—This is a tidal stream rising in and flowing through Gloucester County northwesterly and emptying into the Delaware River about 9 miles below Philadelphia, Pa.

Existing project.—This project (adopted by the river and harbor act of Mar. 4, 1913) provides for a channel 6 feet deep at mean low water from the Delaware River to Woodbury, 60 feet wide across the bar outside the mouth and up the river to the White Bridge, $1\frac{1}{2}$ miles, thence 40 feet wide to Woodbury, 4 miles from the entrance, including three cut-offs, subject to the condition that no work shall be done until parties interested furnish free of cost to the United States the land necessary for the cut-offs and for deposit of dredged material, at an estimated cost of \$38,000. Estimated cost of annual maintenance, \$2,000. (H. Doc. No. 635, 62d Cong., 2d sess., with map.) The section included in the project extends from the Delaware River to Woodbury, 4 miles.

Condition at the end of fiscal year.—The project has been completed. The channel was given a uniform depth of 6 feet from the Delaware River to the fixed highway bridge at Woodbury, including the three cut-offs, which shortened the distance 3,340 feet. The minimum usable depth June 30, 1916, from the Delaware River to Woodbury was 4 feet. The expenditures under the existing project to June 30, 1916, were \$24,142.70 for new work and \$1,215.36 for maintenance, a total of \$25,358.06. The project was completed at a saving of \$13,857.30.

Local cooperation.—The land for the three cut-offs and for the deposit of the dredged material required by law to be furnished by local interests free of cost to the United States was donated by local interests and title to the land was approved by the Department of Justice January 8, 1914.

Effect of improvement.—Navigation has been facilitated, and larger vessels can be used at all stages of the tide. Arrangements are being made by parties interested to avail themselves of the improvement.

Proposed operations.—It is proposed to apply the balance available in dredging for maintenance. Being a new project and the river bed composed largely of mud, the deterioration immediately after the initial work of improvement is much greater and more rapid than after the new conditions have been established. A recent examination shows a large part of the channel between the Delaware River and Woodbury will have to be redredged to restore project dimensions. After the creek has been dredged to project dimensions the second time it is expected, from previous experience in similar waterways, that the project dimensions can be maintained for \$2,000 a year, the amount estimated in the project, and this amount is estimated for the fiscal year ending June 30, 1918.

Commercial statistics.—The general character of commerce for the current year was coal, manure, agricultural products, building materials, and miscellaneous merchandise. It was impracticable to obtain complete commercial statistics.

Comparative statement.

Year.	Short tons.	Value.
1913 ¹		
1914.....	11,270	\$38,390
1915 ¹		
Total.....	11,270	38,390

¹ Impracticable to obtain complete commercial statistics.

Amount expended on all projects from Aug. 2, 1882, to June 30, 1916:

New work.....	\$27,093.01
Maintenance.....	1,215.36
Total.....	28,308.37

Balance available for fiscal year ending June 30, 1917..... 12,491.94

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 2,000.00

. RACCOON CREEK, N. J.

Location and description.—This creek, a tidal stream, rises in Gloucester County, N. J., flows in a northwesterly direction, and empties into the Delaware River about 20 miles below Philadelphia, Pa.

Existing project.—This project (adopted by the river and harbor act of June 13, 1902) provides for a channel 7 feet deep at mean low water, 75 feet wide from the Delaware River to Bridgeport, thence 60 feet wide to Springers Wharf, and thence 5 feet deep and 40 feet wide to Swedesboro; estimated cost, \$102,135. (H. Doc. No. 231, 56th Cong., 1st sess., with map, and Annual Report for 1900, p. 1590.) The mean range of tide at the mouth and at Bridgeport, $1\frac{3}{4}$ miles above, is 6 feet; at Springers Wharf is 5.6 feet; and at Swedesboro, the head of navigation, 5 feet. The section included in the project extends from Delaware River to Swedesboro, $9\frac{3}{4}$ miles. The project was modified by the river and harbor act of March 2, 1907, so as to include the construction of a cut-off at Molonox Shoal without increase of estimated cost.

Condition at the end of fiscal year.—About 95 per cent of the project has been completed. The remaining portion, the widening of sharp bends, is unnecessary at present. The minimum usable depth June 30, 1916, from the Delaware River to Bridgeport was 4 feet; thence to Springers Wharf, 7 feet; and thence to Swedesboro, 4 feet. The total expenditures under the existing project to June 30, 1916, were \$47,906.87 for new work and \$33,792.39 for maintenance, a total of \$81,699.26.

Local cooperation.—The lands necessary for the cut-off at Molonox Shoal were required by law to be deeded to the United States free of cost. This was accomplished March 19, 1908.

Effect of improvement.—The carrying of perishable freight has been facilitated. Bulky freight can now be carried by water for about half the cost of carriage by rail.

Proposed operations.—Contract has been executed for dredging for maintenance with the funds available July 1, 1916, the work to be

done in the upper river and to begin soon. It is proposed to apply the remainder of the funds on hand in dredging for maintenance in the portion of the river near the mouth, and the funds estimated for the fiscal year ending June 30, 1918, in removing the shoals from the improved channel between the Delaware River and Swedesboro, which, previous experience has shown, form annually.

Commercial statistics.—The general character of commerce for the current year was coal, building materials, crude oil, fertilizers, manure, salt, hay, fruit, agricultural products and miscellaneous merchandise.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	89,075	\$1,158,170
1914.....	23,543	350,907
1915.....	89,638	844,290

Amount expended on all projects from Aug. 2, 1882, to June 30, 1916:

New work.....	\$48,664.10
Maintenance	33,792.39

Total	82,456.49
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Balance available for fiscal year ending June 30, 1917.....	5,643.51
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Amount (estimated) required to be appropriated for completion of existing project.....	22,635.00
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	5,000.00
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RACCOON CREEK, N. J.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document No. 800, Sixty-third Congress, second session:

Raccoon Creek is a crooked tidal stream emptying into the Delaware River about 18 miles below Philadelphia. The existing project for its improvement contemplates the formation of a dredged channel 7 feet deep and 75 feet in width at mean low water from the mouth to Bridgeport, thence a channel of the same depth and 60 feet wide to Springer's wharf, and thence a channel 5 feet deep at mean low water and 40 feet in width to the head of navigation at Swedesboro, with a cut-off at Molonox Shoal. This project is practically completed. It appears that the additional improvements now desired are the extension of the 7-foot depth to Swedesboro and the protection of the mouth. The district officer states that the heaviest receipts and shipments are made at the wharves at Swedesboro, for which reason he believes that the full depth of 7 feet should be carried to that point. He further states that a broad shoal has formed at the mouth of Raccoon Creek, which will require annual dredging or the construction of a jetty. The estimated cost of extending the 7-foot channel to Swedesboro and dredging between the mouth of the creek and the 7-foot curve in Delaware River is \$25,300, and the estimated cost of a jetty extending out to the main channel of the Delaware River is \$49,500, making the total cost of the proposed improvement \$74,800. The district officer is of opinion that the stream is worthy of further improvement to this extent. The division engineer concurs in general with the views of the district officer, but recommends that the jetty be built only as far as the eastern side of the inner channel of the Delaware River, which has sufficient depth and connects with the main channel both to north and south. The estimated cost of the work as thus modified is \$39,770.

The Board of Engineers for Rivers and Harbors recommends adoption of the modified plan favored by the division engineer.

I concur in general with the division engineer and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by

the United States of Raccoon Creek, N. J., is deemed advisable under a modification of the existing project providing for a channel 7 feet deep at mean low water from the inner channel of Delaware River to Swedesboro, 75 feet wide to Bridgeport, thence 60 feet wide to Springer's wharf, and thence 40 feet wide to Swedesboro, with a dike at the mouth, at an estimated cost of \$39,770 for first construction and about \$5,000 annually for maintenance. It should be noted that the present project has been practically completed for considerably less than its estimated cost, and that the estimate of the work now proposed is only about \$4,400 more than the unappropriated balance of the estimate for the existing project.

OLDMANS CREEK, N. J.

Location and description.—This creek, a tidal stream, forms a part of the boundary line between Gloucester and Salem Counties, flows northwesterly and empties into the Delaware River about 24 miles below Philadelphia, Pa.

Existing project.—This project was adopted by the river and harbor act of June 25, 1910, and provides for a channel 6 feet deep at mean low water from the Delaware River to Pedricktown and 5 feet deep at mean low water from Pedricktown to Auburn, 100 feet wide across the bar outside of the mouth, 75 feet wide thence to Pedricktown, and 40 feet wide to Auburn, including nine cut-offs and a jetty at the mouth. Estimated cost, \$89,500. Estimated cost of annual maintenance, \$2,500. (H. Doc. No. 1083, 60th Cong., 2d sess., with map.) The section included in the project extends from the Delaware River to Auburn, 9.7 miles.

Condition at the end of fiscal year.—About 50 per cent of the project has been completed. The minimum usable depth June 30, 1916, from the Delaware River to Pedricktown was 5 feet and thence to Auburn 4 feet. The cut-offs shortened the distance from Delaware River to Auburn $4\frac{1}{2}$ miles. The total expenditures under the existing project to June 30, 1916, were \$31,188.43 for new work and \$1,089.09 for maintenance, a total of \$32,277.52.

Local cooperation.—As required by law, the necessary land required for the nine cut-offs was furnished by local interests free of cost to the United States, and the United States was released from all claims for damages arising from the diversion of the stream, title to the land and the releases being approved by the Department of Justice April 17, 1913.

Effect of improvement.—The improvement has been of great benefit to navigation and has facilitated and expedited the carrying of perishable freight.

Proposed operations.—It is proposed to apply the funds available in dredging for maintenance. Being a new project and the river bed composed largely of mud, the deterioration immediately after the initial dredging is much greater than after the new conditions have become established, and necessitates redredging the creek to restore it to project dimensions. The funds available will not be sufficient to restore the entire channel from the Delaware River to Auburn to project dimensions, and it is proposed to apply the funds estimated for, equivalent to the cost of removing two years' shoaling, to supplement the funds available in completing the work of restoration and in maintenance. After this redredging is done it is expected from previous experience in similar waterways that the project dimensions can be maintained for \$2,500 annually.

Since the adoption of the present project a stone dike forming part of the improvement of the Delaware River has been constructed. This dike extends from just below the mouth of the creek to the head of Cherry Island Flats, in the Delaware River. Pending the effect of this dike upon the channel across the bar outside the mouth of the creek no funds are estimated for the construction of the jetty, which is the remaining portion of the project of improvement uncompleted.

Commercial statistics.—The general character of commerce for the current year was manure, fruit, agricultural products, fertilizers, flour, shingles, coal, cordwood, stone, lumber, baskets, phosphate rock, etc.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	88,412	\$812,900.00
1914.....	25,659	250,166.91
1915.....	60,438	423,875.00

Amount expended on all projects from June 25, 1910, to June 30, 1916:

New work	\$31,188.43
Maintenance.....	1,089.09
Total.....	32,277.52

July 1, 1916, balance available.....	5,647.48
Amount (estimated) required to be appropriated for completion of existing project.....	44,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	5,000.00

ALLOWAY CREEK, N. J.

Location and description.—This creek, a tidal stream, rises in Salem County and flows southwesterly, emptying into the Delaware River about 47 miles below Philadelphia, Pa.

Existing project.—This project was adopted by the river and harbor act of September 19, 1890, and provides for a channel 6 feet deep at mean low water from a locality known as the Square upstream to Quinton, 75 feet wide to a point 1,000 feet above Upper Hancock Bridge and thence 60 feet wide to Quinton, supplemented by a dike at the Square and by an increase of width at the canal to 150 feet between low-water lines. Estimated cost, \$25,000. (H. Doc. No. 60, 51st Cong., 1st sess.; Annual Report for 1890, p. 910.) The mean range of tide at the mouth is 6 feet; at Hancock Bridge, 5 feet; and at Quinton, 4 feet. The project was modified in 1896 to include a dike above Upper Hancock Bridge and by the river and harbor act of March 2, 1907, to include the construction of a cut-off at Fosters Bottle. These modifications did not increase the originally estimated cost of the work. The section included in the project extends from 1 mile above the Delaware River to Quinton, 8½ miles.

Condition at the end of fiscal year.—The project has been completed at a saving of \$3,602.27. The minimum usable depth June 30, 1916, was about 4 feet. The total expenditure to the close of the fiscal year 1916 was \$21,397.73 for improvement and \$24,265 for maintenance, a total of \$45,662.73.

Local cooperation.—As required by law, all land needed for the cut-off at Fosters Bottle was furnished by local interests free of cost to the United States, title to the land being approved by the Department of Justice July 30, 1908.

Effect of improvement.—The carrying of perishable freight has been facilitated and vessels are now able to get to Quinton at low tide.

Proposed operations.—It is proposed to apply the balance available in removing shoaling. This amount is not sufficient to restore the channel to protect dimensions in the entire creek under improvement, as there has been deterioration of the channel in numerous places since the last dredging, in 1913, and it is proposed to apply the funds estimated for the fiscal year ending June 30, 1918, in continuing work of restoration. Previous experience on this stream indicates that this sum will be adequate.

Commercial statistics.—The general character of commerce for the current year was coal, cordwood, brick, canned goods, fertilizers, sand, lumber, agricultural products, and general merchandise.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	34,342	\$1,105,483.00
1914.....	8,314	140,181.31
1915.....	19,343	939,015.00

Amount expended on all projects from Sept. 19, 1890, to June 30, 1916:

New work.....	\$21,397.73
Maintenance.....	24,265.00
Total.....	<u>45,662.73</u>
July 1, 1916, balance available.....	4,887.27
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	5,000.00

COHANSEY RIVER, N. J.

Location and description.—This river, a tidal stream, rises in Salem County, flows southerly and southwesterly through Cumberland County, and empties into the Delaware Bay about 62 miles below Philadelphia, Pa. It has a drainage area of about 91 square miles of flat country.

Existing project.—This project was adopted by the river and harbor act of March 2, 1907, and provides for a cut-off 7 feet deep and 100 feet wide at the mouth and for a channel 7 feet deep at mean low water 100 feet wide from Stony Point to Broad Street Bridge, Bridgeton, a distance of 6,000 feet; thence 75 feet wide to Commerce Street Bridge a further distance of 740 feet; and thence 60 feet wide to the Nail Works Bridge, the head of navigation, a further distance of 900 feet, at an estimated cost of \$55,800. (H. Doc. No. 645, 59th Cong., 1st sess.) The mean range of tide is about 5½ feet at the mouth and 7 feet at Bridgeton. Sections included in the project: Cut-off about 2,000 feet in length at the mouth and the upper 1½ miles of river at the head of navigation through the city of Bridgeton.

Condition at the end of fiscal year.—The project has been completed at a saving of \$7,221.11. The minimum usable depth June 30, 1916, between Delaware Bay and Nail Works Bridge was the project depth of 7 feet. Total expenditure under the existing project to close of fiscal year 1916 for original work was \$48,578.89 and for maintenance was \$10,034.54, a total of \$58,613.43.

Local cooperation.—The land required for the cut-off at the mouth was voluntarily conveyed to the United States free of cost; title being approved by the Department of Justice September 21, 1910.

Effect of improvement.—The effect of the improvement on freight rates has not been reported, but it has facilitated and expedited shipments of fruits and other perishable merchandise. The cut-off at the mouth saves 3 miles to and from points up Delaware River and assures a deeper entrance.

Proposed operations.—It is proposed to apply the balance available in maintenance by dredging. This amount is not sufficient to restore the channel to project dimensions, and it is proposed to combine it with the funds estimated for the fiscal year ending June 30, 1918, in redredging the channel from Stony Point up through the city of Bridgeton to the Nail Works Bridge. No dredging has been done on this river since 1913, and the channel is subject to slow deterioration. Experience indicates that the combined amounts available and estimated for will be sufficient for the work described.

Recommended modifications of project.—None.

Commercial statistics.—The general character of commerce for the current year was coal, lumber, oysters, cereals, hay, farm produce, fertilizers, lumber, and general merchandise.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	50,186	\$605,190.00
1914.....	33,426	427,425.00
1915.....	63,802	898,472.8

Amount expended on all projects to June 30, 1916:

New work.....	\$84,578.89
Maintenance.....	10,034.54

Total.....	94,613.43
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July 1, 1916, balance unexpended.....	3,786.57
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....

5,000.00

MAURICE RIVER, N. J.

Location and description.—This river, a tidal stream, rises in Gloucester County, flows southerly and southwesterly through Cumberland County, and empties into Delaware Bay, through Maurice Cove, about 89 miles below Philadelphia, Pa. It has a drainage area of about 377 square miles of flat country. The navigable length of the stream is 24 miles.

Existing project.—This project was adopted by the river and harbor act of June 25, 1910, and provides for a channel 7 feet deep at mean low water across the bar at the mouth in Maurice Cove and up to the head of navigation at Millville, including a turning basin at the upper end, the width to Millville Bridge to be 100 feet, and thence 60 feet to the mill dam, at an estimated cost of \$156,200 (H. Doc. No. 664, 59th Cong., 1st sess., with map.) The mean range of tide is 5 feet at the mouth and 6 feet at Millville. The sections of river included in the project are from the mouth out to the 7-foot contour in Delaware Bay, a distance of 3 miles, and from French Bar upstream to the head of navigation, at Millville, a distance of 4 miles.

Condition at the end of fiscal year.—About 45 per cent of the project has been completed. The minimum usable depth June 30, 1916, across the bar in Maurice Cove was 6 feet and in the river 5.5 feet. Total expenditures under the existing project to close of the fiscal year for original work, \$63,954.20, and for maintenance, \$6,285.41, a total of \$70,239.61.

Effect of improvement.—Larger vessels can now be used, and in consequence there is a larger output from the sand deposits, and vessels can now be operated to Millville at low tide. The full effect and value of the improvement can not be determined until the channel outside the mouth is completed.

Proposed operations.—It is proposed to apply the balance available to the extension of the improvement by dredging the channel across Maurice Cove to

project depth, as far as the available funds will go, and to use the funds estimated for the fiscal year ending June 30, 1918, toward completing the channel across Maurice Cove and in continuing the improvement of the river and maintenance of the dredged channel in the upper river, where the river bed is sandy and subject to considerable deterioration. No work has been done in the upper river since 1913.

Commercial statistics.—The general character of the commerce for the current year was coal, fish, oysters, hay, molding sand, bricks, fertilizers, and agricultural products.

Comparative statement.

Year.	Short tons.	Value.
1913.....	526,448	\$2,356,676.00
1914.....	193,507	1,921,028.88
1915.....	195,160	1,519,598.50

Financial summary.

Amount expended on all projects to June 30, 1916:	
New work.....	\$106,954.20
Maintenance	6,285.41
Total	113,239.61
Balance available for fiscal year ending June 30, 1917.....	11,685.39
Amount (estimated) required to be appropriated for completion of existing project	
	74,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement and for maintenance.....	
	25,000.00

TUCKERTON CREEK, N. J.

Location and description.—This creek, a tidal stream, rises and flows southeasterly through Ocean County into Little Egg Harbor, about 8 miles north of Little Egg Inlet.

Existing project.—This project was adopted by the river and harbor act of June 13, 1902, and provides for a channel 6 feet deep at mean low water, 80 feet wide from Gaunts Point, seven-eighths of a mile to the mouth of the creek; thence up the creek, 75 feet wide, 1 mile to Parkers Landing; thence 60 feet wide five-eighths of a mile to West Tuckerton Landing; thence 5 feet deep at mean low water and 60 feet wide three-eighths mile to just above Scow Landing; and thence 3 feet deep at mean low water and 40 feet wide one-eighth mile to milldam at Tuckerton. Estimated cost, \$61,380. (H. Doc. No. 274, 56th Cong., 1st sess.) The river and harbor act of March 3, 1905, modified the project, substituting for the channel from the mouth of the creek to Gaunts Point a channel from the mouth of the creek to the head of Marchelder Channel, a distance of about 1½ miles, and eliminated the revetment wall, with the proviso that the cost of completion shall not exceed the estimate heretofore made for such improvement. The mean range of tide throughout the creek is 2½ feet. The section included in the project extends from the head of Marchelder Channel to Tuckerton, a distance of 3¾ miles.

Condition at the end of fiscal year.—About 97 per cent of the project has been completed. The minimum usable depth across

Little Egg Harbor from the head of Marchelder Channel to the mouth of the creek is 6 feet, and to Scow Landing 4 feet, and to Tuckerton 2 feet. The total expenditures to June 30, 1916, were, for new work, \$59,742.16, and for maintenance, \$23,602.68, a total of \$83,344.84.

Local cooperation.—Consent by the owner of property at the mouth of the stream was given to the cutting off of the point of land. There are three municipal wharves or public landings along the creek, the cost of which is not known.

Effect of improvement.—Navigation is now possible at low tide. No effect on freight rates has been reported and none is expected, as there is no competition.

Proposed operations.—The balance available is too small for any operation. It is proposed to apply the funds estimated for the fiscal year ending June 30, 1918, in redredging the creek above the point where work was done during the present fiscal year. It is estimated that about 22,500 cubic yards can be removed with the amount estimated for, and this will restore the channel to project dimensions to the public landing in Tuckerton, where the greater portion of navigation ends. The cost of dredging at this locality is high, as dredging plants must be brought from distant points to do the work.

Commercial statistics.—The general character of the commerce for the current year was fish, oysters, clams, fertilizer, sand, lumber, garden and farm produce, and ice.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	16,755	\$472,400
1914.....	8,818	389,125
1915.....	21,997	901,929

Amount expended on all projects from June 13, 1902, to June 30, 1916:

New work.....	\$59,742.16
Maintenance.....	23,602.68

Total	<u>\$83,344.84</u>
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July 1, 1916, balance unexpended.....	35.16
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	5,000.00
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HARBOR AT PITTSBURGH, PA.

Location and description.—The Allegheny and Monongahela Rivers join at Pittsburgh to form the Ohio. The harbor extends from Davis Island Dam on the Ohio to the head of the river at Pittsburgh, a distance of 4.7 miles; up the Allegheny River 7 miles to Aspinwall; and up the Monongahela River to McKeesport, a distance of 15.5 miles, making the total length of harbor 27.2 miles.

Existing project.—The existing project was adopted by the river and harbor act of March 3, 1899. It contemplated improvement at an estimated cost of \$110,662.90 and maintenance at an annual cost of \$10,000. (See Annual Report for 1899, p. 2399.) As regards im-

provement, the project provided for dredging a channel in the lower harbor 10 feet deep at normal pool level and 500 feet wide below Smithfield Street Bridge, Monongahela River, and of less width above this bridge and in the Allegheny River, limited by lines from ends of channel spans of successive bridges, except at the Panhandle Railroad bridge, Monongahela River, where the width was to be 570 feet, including two channel spans. Provision was also made for raising the old riprap dam across the Brunot Island back channel for the establishment of harbor lines and for the removal of obstructive fillings beyond the harbor lines. With respect to improvement the project is completed. As regards maintenance, it contemplates dredging and snagging with a view of maintaining average channel widths as follows: On the Ohio, about 1,100 feet; on the Allegheny, about 930 feet; and at different parts of the Monongahela, from 750 to 950 feet; maintenance of harbor lines and inspection incident thereto, all as provided for by river and harbor acts from time to time. The present estimated annual cost is \$5,000.

Condition at the end of fiscal year.—The project as regards improvement was completed in the fiscal year 1904. The condition of the harbor is such as meets the requirements of navigation at the present time, except that navigation on the Allegheny River above the Sixth Street Bridge is restricted by low bridges and that at times in the winter months, when Davis Island Dam is lowered, there is insufficient depth. During the last five years 6 and 9 foot navigation have been possible an average of 319 and 213 days, respectively. The minimum depth in the lower harbor has been increased from less than 8 to 10 feet. The increased channel widths contemplated by the project are being maintained. The total expenditure to end of fiscal year was \$110,662.90 for improvement and \$70,353.49 for maintenance, a total of \$181,016.39.

Local cooperation.—The city of Pittsburgh has improved the public wharf along the right bank of the Monongahela River by paving and constructing a system of roadways at a cost of \$21,901.95. The extensive dredging of sand and gravel by private interests has considerably improved the harbor conditions.

Effect of improvement.—The effect of improvement has been to lengthen the period of navigability, as well as to render navigation easier and safer. The harbor improvement has also made available to the city of Pittsburgh the general improvement of the rivers of the district, and consequently aids these improvements in their effect on freight rates, as reported elsewhere.

Proposed operations.—It is proposed to use the funds which are shown as available for the year ending June 30, 1917, as follows: (1) The patrol of banks, to prevent improper deposits and encroachments beyond established harbor lines, \$920; (2) field and office work in connection with maintenance of harbor-line markings, \$900; (3) inspection of work being done under department permits, \$840; (4) examination and study of drawings submitted with applications for permits, \$660; (5) supervision of dredging and scraping at landings, etc., and examination of same upon completion, \$360; (6) cost of operation of inspection and survey boat *Kittanning*, which will be used part time on all items except (4), \$1,578. Under this distribution the available funds will be exhausted about June 30, 1917.

It is proposed to continue these operations in connection with the maintenance of the harbor during the fiscal year 1918, as follows:

(1) The patrol of banks to prevent improper deposits and encroachments beyond established harbor lines-----	\$830
(2) Field and office work in connection with maintenance of harbor-line markings-----	790
(3) Inspection of work being done under department permits-----	740
(4) Examination and study of drawings submitted with applications for permits-----	570
(5) Supervision of dredging and scraping at landings, etc., and examination upon completion-----	330
(6) One-fourth total cost of operation of inspection and survey boat <i>Kittanning</i> , which will be used part time on all items except (4) --	1,740
Total-----	5,000

The average amount expended during the last three years is about \$4,000. This being less than the amount requested for the fiscal year 1918 is due to the fact that the appropriation of \$7,500 of March 4, 1915, was not allotted until April, 1915, which accounts for the small expenditure of \$2,712.61 in the fiscal year 1915.

Commercial statistics.—There is given below a comparative statement of the commerce for the past three years, which consisted principally of coal, sand, gravel, iron, and steel products. For 1915 the tonnage was distributed among these classes as follows: Coal, 79 per cent; sand and gravel, 18 per cent; iron and steel products, 1.2 per cent, leaving about 2 per cent for miscellaneous items. The usual limits of draft for this commerce are 6 feet to 8½ feet for coal and iron and steel products and 4 feet to 7½ feet for sand and gravel. A packet line operating one boat between Pittsburgh and Greensboro, Pa., on the Monongahela River was established during the year. The following craft were operated: 76 towboats, 7 sand-and-gravel dredges, 7 packet boats, 3 excursion boats, 4 ferryboats, and about 80 gasoline launches used for ferry, towing, and pleasure purposes.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	13,308,796	\$27,056,709
1914.....	11,143,390	23,023,701
1915.....	12,622,955	28,169,463

Amount expended on all projects from Mar. 3, 1879, to June 30, 1916:

New work-----	\$110,662.90
Maintenance-----	70,353.49

Total-----	181,016.39
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Balance available for fiscal year ending June 30, 1917-----	5,258.26
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	5,000.00
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SCHUYLKILL RIVER, PA.—NEW PROJECT.

Report of the Chief of Engineers. printed in House Document 1270, Sixty-fourth Congress, first session:

The Schuylkill River empties into the Delaware River at Philadelphia. The upper portion has been canalized by the Schuylkill Navigation Co., beginning about 8½ miles above the mouth. The lower part was improved by the United

States between 1870 and 1901, since which time the channel has been improved and maintained by the city. The commerce of the river amounts to about 3,000,000 tons a year, a considerable part of which is carried in deep-draft vessels. In view of the embarrassments experienced by vessels now in use and the demand for the use of larger vessels which are now debarred by inadequate channel facilities the district officer believes that a channel of increased dimensions should be provided. He submits an estimate of cost amounting to \$1,532,960 for undertaking improvement under a plan suggested by the Board of Engineers for Rivers and Harbors providing for a channel 30 feet deep and 400 feet wide from Delaware River to Twenty-ninth Street, thence 30 feet deep and 300 feet wide to Passyunk Avenue Bridge, thence 26 feet deep and 200 feet wide to Gibsons Point, and thence 22 feet deep and 200 feet wide to Cleveland Avenue, with suitable widening at bends. Further investigations by the district officer, particularly with reference to the needs of the naval reserve basin at Girard Point, led him to the conclusion that the channel from Delaware River as far upstream as Girard Point should be given a depth of 35 feet, at an additional cost of \$116,213, making the total cost of the project \$1,649,173. To this extent he believes that the locality is worthy of improvement by the United States, provided the city of Philadelphia or the State of Pennsylvania will maintain the improved channel until the sewage-treatment works shall have been completed and placed in operation. The district officer considers that this work of maintenance, taken in connection with the dredging already done and the bulkheading of the channel now in progress, is a sufficient degree of cooperation on the part of local interests. The division engineer concurs in the recommendations of the district officer.

The Board of Engineers for Rivers and Harbors is of opinion that it is advisable for the United States to undertake the work as proposed by the district officer, but believes that dredging to a greater depth than 30 feet in the section below Girard Point should be deferred until such greater depth has been secured in the main Delaware River Channel.

I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Schuylkill River from the Delaware River to South Street Bridge is deemed advisable to the extent of providing a channel 35 feet deep at mean low water and 400 feet wide from Delaware River Channel to Girard Point, thence 30 feet deep and 400 feet wide to Twenty-ninth Street, thence 30 feet deep and 300 feet wide to Passyunk Avenue Bridge, thence 26 feet deep and 200 feet wide to Gibsons Point, and thence 22 feet deep and 200 feet wide to Cleveland Avenue, suitably widened at bends, at a total estimated cost of \$1,649,173 for first construction and about \$45,000 annually for maintenance, provided the city of Philadelphia or the State of Pennsylvania shall maintain the improved channel until the projected sewage-treatment works shall have been completed and placed in operation, and provided further that no depth in excess of 30 feet at mean low water shall be provided or maintained in the lower section of the river from the mouth to Girard Point until such greater depth has been secured in the main Delaware River Channel from Philadelphia to the sea.

DELAWARE RIVER, PA., N. J., AND DEL., PHILADELPHIA, PA., TO THE SEA.

Location and description.—The Delaware River has its sources in Green, Schoharie, and Delaware Counties, in southeastern New York. It flows in a general southerly direction, forms the boundary line between the States of New York and New Jersey on the east, and Pennsylvania and Delaware on the west, and empties into Delaware Bay. The total length of the river is about 315 miles. The distance by the river from Philadelphia Harbor to the harbor of refuge at the mouth of Delaware Bay is about 101 miles. The section included in this project is about 63 miles in length, and extends into Delaware Bay for a distance of about 8 miles below the mouth of the river at Liston Point, the accepted point of division between Delaware River and Bay. The distance from the mouth of the river at Liston Point to the Atlantic Ocean is about 50 miles. (See U. S. Coast and Geodetic

Survey Charts Nos. 294, 295, and 296.) The distance from Allegheny Avenue, Philadelphia, to Lalor Street, Trenton, is about 30 miles.

Existing project.—The existing project, adopted by the river and harbor act of June 25, 1910, provides for a channel from Allegheny Avenue, Philadelphia, to deep water in Delaware Bay, with a depth of 35 feet at mean low water, and a width of 1,000 feet in Philadelphia Harbor, 1,200 feet at Bulkhead Bar Shoals, 1,000 feet at the other bends, and 800 feet in the straight parts, and for the construction of five dikes and the topping off and extension of three existing dikes, for the better regulation and control of the tidal flow, at an estimated cost of \$10,920,000 for original work and \$300,000 annually for maintenance, in accordance with the report published (with maps) in House Document No. 733, Sixty-first Congress, second session.

It is estimated that to complete the projected channel will require the removal, by dredging, of about 73,208,000 cubic yards of soft material, and the removal of about 53,260 cubic yards of ledge rock from Philadelphia Harbor. No modification has been made in the existing project since its adoption. The mean range of tide at various points of the river is as follows: Philadelphia, Pa., 5.3 feet; Fort Mifflin, Pa., 5.5 feet; Billingsport, N. J., 5.6 feet; Chester, Pa., 5.8 feet; Marcus Hook, Pa., 5.9 feet; Edgemoor, Del., 6 feet; New Castle, Del., 6 feet; Liston Point, Del., 5.9 feet; and Lewes, Del., 4.4 feet.

Condition at end of fiscal year.—At the end of the fiscal year the existing project was about 39 per cent completed. The total quantity of material dredged was approximately 25,554,000 cubic yards, or about 35 per cent of the total quantity to be removed to complete the project. The total quantity of stone placed in the dikes included in the project was approximately 628,000 tons, which is about 54 per cent of the total dike work contemplated. The total length of channel completed to the project dimensions was approximately 24 miles, continuous from Greenwich Point, at the lower end of Philadelphia Harbor, to a point just above New Castle, Del., except for one gap of 0.7 mile, where contract for dredging was annulled before completion, two gaps aggregating 0.3 mile, where small areas of ledge rock exist in one-half of the channel, and one gap of 3 miles, opposite Wilmington, Del., where contract dredging has been postponed pending the completion of the Edgemoor Bulkhead extension. The portions of the channel which have not been excavated to the depth contemplated by the existing project are being maintained by Government plant. The controlling depth at the end of the fiscal year was 30 feet at mean low water. Two of the new dikes included in the existing project, those at Chester Island and Old Man Point, have been completed and work on the others is in progress. The total amount expended in connection with the existing project to the end of the fiscal year was \$6,162,276.92, of which \$4,185,875.46 was for new work and \$1,976,401.46 was for maintenance.

Local cooperation.—The existing project was adopted without special conditions being imposed. A comprehensive plan for enlarging and improving the terminal facilities of the city of Philadelphia has been inaugurated by that municipality. From 1854 to June 30, 1916, the city of Philadelphia, the State of Pennsylvania, and the Girard estate of Philadelphia have appropriated jointly the sum of \$33,022,831.76 (which amount includes a loan of \$13,300,000 recently

authorized by the city of Philadelphia) for the purchase of sites and construction of piers and bulkhead in the Delaware and Schuylkill Rivers at Philadelphia; the construction and maintenance of meadow banks on the Delaware and Schuylkill Rivers; the purchase of ice-breaking boats and dredging plant; and other expenses incidental thereto.

At the present time the city of Philadelphia owns 22 piers in the Delaware River, which were constructed at an approximate cost of \$3,052,000. This number includes 4 modern steel and concrete piers having a length of from 551 feet to 582 feet and a width of from 120 feet to 180 feet, which have been constructed since 1909. The city of Philadelphia now has under construction a modern steel and concrete double-deck pier, 900 feet by 250 feet, in the Delaware River at the foot of McKean Street, which will cost approximately \$1,600,000 to complete.

Since 1899 the city of Philadelphia has removed approximately 8,115,000 cubic yards of material from within the limits of the main ship channel in the Delaware River between Port Richmond, at the upper end of Philadelphia Harbor, and the south line of the State of Pennsylvania. The cost of this item of work is approximately \$1,552,000.

In addition to the above the city of Philadelphia has removed approximately 2,996,000 cubic yards of material in deepening and maintaining the channel of the Schuylkill River, at an approximate cost of \$895,000. The city has also removed about 107,000 cubic yards of material in widening, deepening, and maintaining the channel in Frankford Creek, in the upper part of the harbor, at a cost of approximately \$18,000.

At the present time the city owns and operates three ice-breaking boats, to keep the river channel open during the winter months. The city also owns and operates a dredging plant consisting of one 18-inch hydraulic dredge, one 6-cubic-yard clamshell grapple dredge, and one 1-cubic-yard orange-peel grapple dredge, with attendant plant, which is used in dredging the channels of the Delaware and Schuylkill Rivers and in dredging out docks on the same waterways.

There are 157 privately owned piers in the Delaware River at the port of Philadelphia. The lengths and width of these piers vary from about 100 feet to about 900 feet, and from about 40 feet to about 200 feet, respectively.

A detailed report of the work done by the city of Philadelphia and other local interests in connection with the improvement of the harbor facilities at the port of Philadelphia is contained in the report of the district officer.

Effect of improvement.—Work on the improvement is not sufficiently advanced to affect foreign and coastwise freight rates to any appreciable extent as yet. The work so far completed in the upper part of the channel has greatly facilitated the movements of the larger and deeper draft vessels. Freight rates by regular steamship lines plying between points located on the section of the river under improvement average about 25 per cent less than railroad rates between like points. Rates on freight carried by small craft through the improved section of the river average about 50 per cent of railroad rates.

Proposed operations.—It is proposed to expend about \$597,000 of the funds now available as follows:

Maintenance of existing channel with Government plant during the fiscal year 1917-----	\$325, 000
Completing stone revetment around Artificial Island in the lower Delaware River to provide a place for the reception of material dredged in maintaining the channel-----	110, 000
Renewal of boilers on United States plant employed in maintenance work-----	67, 000
Trial of U. S. dredge <i>New Orleans</i> (Fruhling type), belonging to the New Orleans district, with a view of transfer of same in exchange for a dredge belonging to this district-----	50, 000
Construction of storehouse at Fort Mifflin-----	25, 000
Filling wharves and bulkhead at Fort Mifflin, filling and grading the shore approach thereto, and dredging the river approach to the same-----	20, 000
Total-----	597, 000

It is expected that all funds reserved for maintenance will be exhausted by June 30, 1917. It is proposed to expend the balance of the available funds, amounting to approximately \$1,837,400, in continuing the construction of the 35-foot channel by dredging and dike construction now under contract and by entering into new contracts for the removal of approximately 10,000,000 cubic yards of soft material, by extending the existing Edgemoor Dike from its present terminus to the mouth of the Christiana River, by removing the Mameluke Rock area in Philadelphia Harbor, to which work the sum of \$600,000 authorized to be contracted for by the river and harbor act of July 27, 1916, will be applied, and by removing three isolated rock areas on Tinicum, Chester, and Marcus Hook lighthouse ranges, about 17 miles below Philadelphia. It is expected that all dredging will be completed by December 31, 1917; that the Edgemoor Dike will be completed by June 30, 1918; that the isolated rock areas on Tinicum, Chester, and Marcus Hook lighthouse ranges will be completed by December 31, 1917; and that the Mameluke Rock area will be removed by December 31, 1919.

It is estimated that the sum of \$2,020,000 can be profitably expended during the fiscal year 1918, in continuing the work under the existing project. The work which it is proposed to carry on under this estimate is as follows:

Operation and repair of maintenance plant, consisting of two seagoing suction dredges, one hydraulic dredge and attendant plant, for one year from July 1, 1917-----	\$325,000
Removal of Mameluke Rock under continuing contract-----	150,000
Removal of approximately 8,360,000 cubic yards of material by contract, at an estimated cost of 12½ cents per cubic yard-----	1,045,000
Completion of Edgemoor Bulkhead to the mouth of Christiana River, in accordance with the approved project-----	275,000
Engineering and contingencies-----	225,000
Total-----	2,020,000

Owing to the increased cost of coal, supplies, and labor, the estimate of funds required for maintenance work has been increased from \$300,000 to \$325,000 per annum.

Commercial statistics.—Foreign commerce at the port of Philadelphia during 1915 shows an increase of nearly 10 per cent in both tonnage and value over 1914. Imports show a falling off from 1914, but exports show an increase of more than 1,100,000 tons and a valua-

tion nearly double that of 1914. The principal commodities carried during the year consisted of coal, lumber, ores, iron, and steel products, oil, sugar, grain, food stuffs, and general merchandise. The usual loaded draft limits of vessels engaged in foreign and coastwise trade calling at Philadelphia or other points on the Delaware River are approximately as follows:

Transoceanic:	Feet.	Coastwise:	Feet.
General cargo carriers-----	29.5	General cargo carriers-----	21.0
Ore carriers-----	29.0	Coal barges-----	22.0
Oil carriers-----	30.0	Lumber carriers-----	18.0
Grain carriers-----	27.0		
Sugar carriers-----	29.0		
Iron and steel carriers-----	28.0		

The tabular statement following shows the amount and value of the commerce carried during the past three calendar years:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	26,569,352	\$1,229,454,962
1914.....	24,817,952	1,033,229,869
1915.....	26,189,790	1,116,529,839

Amount expended on all projects from Apr. 6, 1802, to June 30, 1916:

New work-----	\$17,187,841.98
Maintenance-----	3,001,810.48
Total-----	20,189,652.46

Balance available for fiscal year ending June 30, 1917-----	2,434,399.17
Amount of continuing-contract authorization, act of July 27, 1916-----	600,000.00
Amount yet to be appropriated-----	600,000.00
Amount (estimated) required to be appropriated for completion of existing project-----	4,200,000.00

Amount that can be profitably expended in fiscal year ending June 30, 1918¹:

For works of improvement-----	¹ 1,695,000.00
For maintenance of improvement-----	325,000.00
Total-----	¹ 2,020,000.00

DELAWARE RIVER, PA. AND N. J., PHILADELPHIA, PA., TO TRENTON, N. J.

Location and description.—(See preceding report.)

Existing project.—The existing project was adopted by the river and harbor act of June 25, 1910, and provides for the construction of a channel 200 feet wide and 12 feet deep at mean low water from Allegheny Avenue, Philadelphia, to Lalor Street, Trenton, in accordance with the report printed (without map) in House Document No. 702, Sixty-first Congress, second session. It was estimated that the original work on this project would involve an expenditure of \$360,000, and that \$20,000 per annum would be required to maintain

¹ Of this amount \$150,000 is for appropriation in the next sundry civil act for continuing-contract work authorized by the river and harbor act of July 27, 1916.

the channel. A map of this improvement is published in the Annual Report of the Chief of Engineers for 1914, page 1804.

Condition at the end of fiscal year.—All work contemplated under the project was completed during the fiscal year 1913, with the exception of the dike at the upper end of Mud Island (about 9.5 miles above Allegheny Avenue). The construction of this dike has been deferred until its necessity can be more fully determined by observations extending over several years. Considerable shoaling has occurred at a number of places since the completion of the channel. A small amount of maintenance dredging has been done during each fiscal year since 1913, the total quantity of material removed being approximately 40,000 cubic yards, but the complete removal of shoals was not accomplished during any of these years. An examination of the channel, made during the latter part of June, 1916, indicates that approximately 160,000 cubic yards of dredging will be required to restore the channel to project dimensions. The controlling depth at the end of the fiscal year was 10 feet at mean low water. The total expenditures under the project have been \$342,173.04, of which \$310,979.21 was for new work and \$31,193.83 for maintenance.

Local cooperation.—No conditions requiring local or State cooperation were imposed by the adopted project and no improvements of any consequence have been made in water terminal facilities on this section of the river, except at Trenton, N. J., details of which are contained in the report of the improvement of the river from Lalor Street, Trenton, to the upper railroad bridge.

Effect of improvement.—The improvement has enabled medium draft seagoing vessels to receive and discharge cargoes at several large industrial plants located on this section of the river, and permits the regular lines of packet boats to run on schedule time between Philadelphia and Trenton. There has been no appreciable effect on freight rates on commerce confined to this section of the river.

Proposed operations.—Considerable shoaling has taken place in the channel between Mud Island opposite Delanco, N. J., and Burlington, N. J. It is estimated that it will be necessary to remove about 160,000 cubic yards of material to restore the channel to the project depth. It is proposed to expend the funds now available, amounting to \$32,843, in the restoration of the channel. It is expected that this work will be completed on or before June 30, 1917.

Based upon previous experience, it is anticipated that maintenance of the channel during the fiscal year 1918 will require the removal of about 75,000 cubic yards of material. It will also be necessary to repair the Bordentown and Kinkora dikes by facing them with rip-rap stone, to replace the original facing of gravel and cobbles, which has been carried away by freshets. It is estimated that during 1918 it will cost about \$15,000 to remove the shoals from the channel and about \$25,000 to make the repairs necessary to the dikes.

Commercial statistics.—The commerce on this section of the river consists principally of bricks, coal, dairy and farm products, general merchandise, clay and iron pipe, pig iron, sand, gravel, and stone. Approximately 78 per cent of the total tonnage is carried in barges of 9 to 12 feet draft, 13 per cent in canal boats of 5 to 5½ feet draft, and the remainder in sailing vessels and steamers of 6 to 9 feet draft. There are now three lines of passenger steamers plying between Philadelphia and Trenton, one of which was established during the

fiscal year. The improvement has not affected freight rates to any extent, nor the nature of the commerce carried, nor has it affected to any marked degree the amount and value of commercial movements. The amount and value of the commerce carried during the past three calendar years are as follows:

Comparative statement.

Year.	Short tons.	Value.
1913.....	1,869,521	\$8,914,441
1914.....	1,712,271	11,254,950
1915.....	1,782,422	16,196,779

Amount expended on all projects from ————, 1872, to June 30, 1916:

New work.....	\$508,602.46
Maintenance.....	31,193.83
Total.....	539,796.29

Balance available for fiscal year ending June 30, 1917.....	32,843.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	40,000.00

DELAWARE RIVER, N. J., LALOR STREET, TRENTON, TO UPPER RAILROAD BRIDGE.

Location and description.—See Delaware River, Philadelphia to the sea.

Existing project.—The existing project was adopted by the river and harbor act of July 25, 1912, and provides for the construction by dredging of a channel 200 feet wide and 12 feet deep at mean low water, with a turning basin of the same depth at its upper end, 300 feet wide and 400 feet long, near the New Jersey side of the river from Lalor Street to the upper railroad bridge at Trenton, a distance of about 1 mile, in accordance with the report published, with map, in House Document No. 839, Sixty-first Congress, second session, and subject to the conditions recommended by the Chief of Engineers on page 2 of said document.

It was originally estimated that the proposed improvement would require the removal of about 426,000 cubic yards of material, at a cost of \$164,000, and that it would require \$5,000 per annum to maintain the improvement. Subsequent examination of the locality, however, indicates that it will be necessary to remove about 517,500 cubic yards of dredged material and about 7,000 cubic yards of ledge rock, and the work will cost about \$301,000.

Condition at the end of fiscal year.—It is estimated that the project is about 39 per cent completed. The channel has been excavated to the full project dimensions for a distance of 1,500 feet above Lalor Street, and to the project depth and one-half the project width for an additional length, not continuous, of about 3,000 feet. At the end of the fiscal year approximately 311,000 cubic yards of dredged material and 63 cubic yards of bowlders had been removed from within the channel limits. The total amount expended in connection with the project to the end of the year was \$108,364.39, all for

new work. The work remaining to be done is the removal by dredging of about 207,000 cubic yards of sand, gravel, clay, and bowlders, and the excavation of between 3,000 and 4,000 cubic yards of ledge rock.

Local cooperation.—The adopted project imposes the condition that the city of Trenton shall provide substantial terminal facilities commensurate with the probable needs of present and prospective commerce. To meet this condition the city of Trenton has taken steps looking to the acquisition of all water-front property abutting on the proposed channel, and has prepared plans for a comprehensive scheme of municipal terminals. The conditions imposed by the adopted project have been met, and the Secretary of War gave his approval thereto on March 19, 1913.

On May 6, 1915, the city of Trenton commenced the construction of a dock 205 feet wide and 12 feet deep at mean low water, and extending inshore 438 feet from the existing pierhead line, at a point about 400 feet below the upper limits of the improvement. This dock will be entirely surrounded by a timber and concrete bulkhead. A double-decked wharf, 70 feet wide, and covered with a shed, will be constructed on the upper side of the dock. Passengers will be landed on the upper deck and freight on the lower deck. A part of the upper deck will be entirely inclosed and used for recreation purposes. It is estimated that the dock and wharf complete will cost between \$90,000 and \$100,000.

About one-half of the excavation for the dock has been completed. No work has been done on the construction of the wharf and bulkhead. The city of Trenton has also constructed an open pile and timber wharf, 100 feet long, at the lower end of the water front. This wharf will be used ultimately for handling low-grade freight. The water front within the city limits of Trenton is 6,735 feet in length, of which the city owns 3,040 feet and has entered condemnation proceedings for the acquisition of an additional 400 feet. A temporary landing wharf has been constructed by the city of Trenton at Lalor Street, and a new line of passenger steamers has been started between Philadelphia and Trenton. There are now three regular lines of steamers plying between the two cities.

Effect of improvement.—Work under the project has not advanced sufficiently to benefit navigation.

Proposed operations.—It is proposed to continue the construction of a channel by dredging, removal of bowlders, and excavation of ledge rock. It is estimated that the funds in hand, amounting to \$102,248.11, will be sufficient to complete all the work included in the project, with the exception of the removal of ledge rock, for which approximately \$90,000, in addition to the funds available, will be required, and an estimate of this amount is submitted for the year ending June 30, 1918.

Commercial statistics.—There is no commerce in this section of the river.

Amount expended on all projects from July 25, 1912, to June 30.

1916, new work_____	\$108, 364. 39
Balance available for fiscal year ending June 30, 1917_____	43, 955. 00
Amount (estimated) required to be appropriated for completion of existing project_____	90, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement_____	90, 000. 00

DELAWARE RIVER, AT CAMDEN, N. J.—NEW PROJECT.

Report of the Chief of Engineers, printed in H. Document 1120, Sixty-third Congress, second session:

Camden is a thriving manufacturing city situated on the Delaware River opposite Philadelphia. The length of the reach under consideration is about $4\frac{1}{2}$ miles. The tidal range is 5.3 feet.

The commerce amounts to about 3,000,000 tons annually, having a value of over \$25,000,000. The greater part of this commerce is carried on light or moderate draft vessels, but in 1912 there were handled 42,099 tons of foreign commerce in deep-draft vessels.

The existing project for the Delaware River in the vicinity of Philadelphia and Camden provides for a channel 35 feet deep and 1,000 feet wide, and authorizes dredging to a depth of 15 feet along the Camden front where such depth does not already exist, increasing in depth, with the bottom sloping uniformly to the edge of the deep-water channel. No work has been done on the existing project along the Camden front. Local interests have requested that depths of from 25 to 35 feet be provided along the $4\frac{1}{2}$ miles of water front, but the district officer believes that the depths suggested are excessive, both for present and probable future requirements. He considers some additional improvement necessary, however, and he proposes the following:

“From Cooper Point Ferry to Kaighn Point Ferry, a channel which at mean lower low water shall have a minimum depth of 18 feet, being considered suitable for boats of a maximum draft of 17 feet.

“From Kaighn Point Ferry to Newton Creek, a channel which at mean lower low water shall have a minimum depth of 30 feet, being considered suitable for boats of a maximum draft of 29 feet.”

The estimated cost of the work proposed is \$86,080. This plan provides better facilities for navigation than would be made available by the present project, and effects a substantial saving in cost. The district officer believes the locality is worthy of improvement to the extent above indicated. The division engineer concurs in this view, and states that the new channel should connect at the north end with the existing 18-foot channel north of Cooper Point.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report, dated June 16, 1914. The board states that local interests have agreed to contribute \$15,000 toward the work, and with this condition it concurs with the district officer and the division engineer in the opinion that it is advisable for the United States to undertake the improvement as proposed.

I concur with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that it is deemed advisable to modify the present project for improvement of the Delaware River from Philadelphia to the sea by providing in the vicinity of Camden a depth of 18 feet from that depth north of Cooper Point to Kaighn Point Ferry, and 30 feet from the latter point to Newton Creek, these depths to extend from the present projected 35-foot channel to a line parallel with and 50 feet distant from the established pierhead line, at an estimated cost of \$86,080, provided local interests will contribute \$15,000 to the work.

WILMINGTON HARBOR, DEL.

Location and description.—The Christiana River, a tidal stream, rises in and flows northeasterly through New Castle County, Del., and through the city of Wilmington, emptying into the Delaware River about 29 miles below Philadelphia, Pa. Its navigable length is 15 miles.

Existing project.—This project is for the formation, by dredging and rock removal, of a channel 21 feet deep at mean low water from the Delaware River to the pulp works, a distance of about 4 miles; thence diminishing to 10 feet at the Philadelphia, Baltimore & Washington Railroad bridge No. 4; and thence 7 feet deep to Newport, a total distance of $8\frac{3}{4}$ miles; 250 feet wide from the Delaware

River to the mouth of the Brandywine; 200 feet thence to bridge No. 4, and 100 feet thence to Newport; also the construction of a jetty at the mouth of the Brandywine, one on the south side of the mouth of the Christiana, and the extension of the north jetty at the mouth of the Christiana. Estimated cost \$476,625. The foregoing project was adopted by the river and harbor act of June 3, 1896, and modified by the river and harbor act of March 3, 1899. (H. Doc. No. 66, 54th Cong., 1st sess.; Annual Report for 1896, p. 973, and for 1897, p. 1250.) The range of tide is 6 feet at the mouth of the Christiana River and about 5.4 feet at Newport. The section of harbor included in the project is the lower 9 miles of the river. The river and harbor act of July 25, 1912, provided for the purchase or construction of a Fruhling-type dredge and auxiliaries, including a wharf and depot, for maintenance of the project. Estimated cost, \$250,000, with \$30,000 annually for operation. (H. Doc. No. 359, 62d Cong., 2d sess.)

Condition at the end of fiscal year.—The project has been completed. The dredge *Minquas* has been completed and assigned to the work of dredging in the harbor. The concrete bulkhead and storehouse were completed and repairs have been made to the jetty. The minimum usable depth June 30, 1916, from the Delaware River to the pulp works was 15 feet; and thence to Newport, 6 feet. The total expenditures under the present project to the close of the fiscal year were \$443,651.63 for new work, and \$741,318.91 for maintenance, a total of \$1,184,970.54.

Local cooperation.—By an act of the Delaware State Legislature passed March 9, 1901, the city of Wilmington was authorized to contribute toward the improvement of Wilmington Harbor to the amount of 10 per cent of the United States Government appropriation to an aggregate not exceeding \$60,000. To the close of the fiscal year the city of Wilmington has contributed \$30,817.11, including interest on the contribution.

Effect of improvement.—The transportation of freight of all classes, at rates slightly less than by rail, has been facilitated.

Proposed operations.—It is proposed to apply the available funds to the completion of the dredge depot, to the operation of the dredge *Minquas*, and to miscellaneous work and expenditures in connection with the improvement, and to apply the amount stated as needed for 1918 to like expenditures. The amount stated as needed is somewhat increased by the fact that no dredging was done between December, 1913, and October, 1915, entailing the removal of about two years' shoaling, and to a large extent to the increased cost of all materials and labor since the estimate was made in 1911.

Commercial statistics.—The general character of commerce for the current year was hides, sand, ship timber, cordwood, coal, cotton, piece goods, nitrate of soda, oil, agricultural products, groceries, chemicals, ores, general merchandise, fiber, iron supplies, leather, building materials, machinery, etc.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	473,382	\$48,270,363.00
1914.....	363,199	63,396,957.04
1915.....	389,713	93,695,494.87

Amount expended on all projects from July 4, 1836, to June 30, 1916:

New work-----		\$845, 772. 84
Maintenance—		
Dredging -----	\$467, 090. 65	
Dredge -----	212, 353. 37	
Depot -----	34, 302. 10	
Maintenance—		
Repairs to north jetty-----	10, 430. 50	
Office expenses, superintendence, inspection-----	17, 142. 29	
		741, 318. 91
Total -----		1, 587, 091. 75

Balance available for fiscal year ending June 30, 1917----- 36, 999. 32

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement----- 50, 000. 00

NOTE.—In addition to the foregoing expenditures the city of Wilmington, Del., to the end of the fiscal year contributed \$30,817.11, including interest, of which amount \$10,911.14 remained unexpended June 30, 1916.

MURDERKILL RIVER, DEL.

Location and description.—This river, a tidal stream, rises in Kent County, Del., flows in a general northeasterly direction, and empties into Delaware Bay about 25 miles above Cape Henlopen.

Existing projects.—This project was adopted by the river and harbor act of July 13, 1892, and provides for a channel 7 feet deep from Delaware Bay to Frederica, 150 feet wide across the flats outside the mouth and 80 feet wide inside the river, at an estimated cost of \$47,550. (H. Doc. No. 21, 52d Cong., 1st sess., and Annual Report for 1892, p. 981.) The mean range of tide at the mouth is 4.8 feet and at Frederica 1.8 feet. The section included in the project extends from Delaware Bay to Frederica, 8½ miles.

Condition at the end of fiscal year.—About 75 per cent of the project is completed. The remainder of the project is unimportant, as it consists of widening the channel across the flats and in the river beyond the dimensions needed by commerce and beyond economical maintenance. The minimum usable depth June 30, 1916, was 7 feet between Delaware Bay and Frederica. The total expenditure under the existing project for new work was \$37,630.07 and for maintenance \$53,145.81, a total of \$90,775.88.

Local cooperation.—Land required for the one cut-off made under the project was voluntarily given free of cost to the United States in 1895.

Effect of improvement.—Freight rates are reported to be 25 to 50 per cent lower by water than by rail, except in wintertime, when the boats can not run. Vessel movements at all stages of the tide have been made possible.

Proposed operations.—The balance available will be applied to re-dredging shoaling in the portion of the river covered by the project. Previous experience has shown that the removal annually of about 30,000 cubic yards will keep the channel free of shoaling that will interfere with navigation. It is proposed to apply the funds estimated for the fiscal year ending June 30, 1918, in similar work of maintenance.

Commercial statistics.—The general character of commerce for the current year was coal, fish, oysters, clams, stone, lumber, hay, fertilizers, canned goods, empty cans, agricultural products, and general merchandise.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	35,082	\$1,431,950.00
1914.....	26,269	924,870.20
1915.....	32,945	1,012,955.50

Amount expended on all projects from July 13, 1892, to June 30, 1916:

New work.....	\$37,630.07
Maintenance.....	53,145.81
Total.....	90,775.88

Balance available for fiscal year ending June 30, 1917.....	5,115.11
Amount (estimated) required to be appropriated for completion of existing project.....	12,264.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	(¹)

MISPILLION RIVER, DEL.

Location.—This river, a tidal stream, rises on the boundary line between Maryland and Delaware, flows northeasterly between Kent and Sussex Counties, and empties into Delaware Bay about 16 miles above Cape Henlopen.

Existing project.—This project was adopted by the river and harbor act of March 2, 1907, and provides for a channel 4 feet deep and 150 feet wide across the bar outside of the mouth, protected by a jetty along the south side, and 6 feet deep at mean low water and 60 feet wide, increasing to 75 feet at sharp bends, from the mouth to Milford, at an estimated cost of \$87,065. (H. Doc. No. 102, 56th Cong., 2d sess.) The mean range of tide at the mouth is 4½ feet and at Milford 3½ feet. The section included in the project extends from Delaware Bay to Milford, a distance of 14 miles.

Condition at the end of fiscal year.—About 90 per cent of the project has been completed. The remaining portion, which consists of widening several sharp bends in the river, is unimportant and not necessary to facilitate navigation. The minimum usable depth June 30, 1916, across the bar outside the mouth was 4 feet and in the river 4 feet. The total expenditures under the existing project to June 30, 1916, were \$70,408.34 for new work and \$53,557.35 for maintenance, a total of \$123,965.69.

Effect of improvement.—Freight rates are reported to have been reduced an average of 25 per cent, and the greater depth of water permits the movement of vessels in the river at low water.

Proposed operations.—It is proposed to apply the available balance in continuing work of repairs to jetties by filling the remaining portions with stone where it has settled and in continuing the dredging for maintenance upstream toward Milford. These

¹ See consolidated financial summary at end of following item.

funds will not be sufficient to complete the dredging to Milford, and it is proposed to apply the funds estimated for the fiscal year ending June 30, 1918, in continuing to completion the dredging operations to Milford, which are estimated to then require the removal of about 60,000 cubic yards.

Commercial statistics.—The general character of commerce for the current year was raw bone, phosphate rock, fertilizers, coal, lumber, canned goods, timber, agricultural products, and general merchandise.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	157,150	\$6,155,600.00
1914.....	24,492	576,523.40
1915.....	31,778	1,014,346.68

It is thought that the statement represents only a fraction of the actual commerce on the stream during 1915.

Amount expended on all projects from 1879, to June 30, 1916:

New work	\$148,798.41
Maintenance	53,557.35

Total.....	202,355.76
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Balance available for fiscal year ending June 30, 1917.....	10,000.31
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Amount (estimated) required to be appropriated for completion of existing project.....	7,000.00
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	(¹)
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CONSOLIDATED.

Amount expended on all projects from 1879 to June 30, 1916:

New work	223,401.83
Maintenance	136,940.64

Total.....	360,342.47
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Balance available for fiscal year ending June 30, 1917.....	15,151.50
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Amount (estimated) required to be appropriated for completion of existing projects.....	21,264.00
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	20,000.00
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MISPILLION RIVER, DEL.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 678, Sixty-second Congress, second session:

The river is now being improved by the United States under a project which provides for dredging a channel 6 feet deep at mean low water and 60 feet wide on bottom, increasing to 75 feet at sharp turns, from the head of navigation at Milford to the mouth, a distance of about 13 miles; thence 4 feet deep and 150 feet wide across the flats, and the protection of the channel across the flats by a jetty. The improvement now desired is the making of a number of cut-offs to eliminate some sharp bends and shorten the distance between Milford and Delaware Bay, and an increase in the depth across the flats to 6 feet to correspond with the project depth in the river.

¹ See consolidated financial summary following.

The district officer presents a plan for further improvement as follows: (a) Excavate five cut-offs in the river 6 feet deep and 50 feet wide on bottom, thereby shortening the distance up to Milford about $2\frac{1}{2}$ miles and eliminating several long tortuous bends and sharp turns and rendering future maintenance more economical, as explained in his report; (b) restore the present river channel to project dimensions, 6-foot depth and 60-foot width where necessary; (c) dredge across the flats to a depth of 6 feet over a width of 80 feet instead of 150 feet; and (d) extend the existing south jetty 750 feet. This plan is estimated to cost \$70,400, and \$5,000 annually for maintenance, and is recommended by the district officer and by the division engineer.

The Board of Engineers for Rivers and Harbors concurs with the district officer and the division engineer in recommending the improvement of this locality as proposed, subject, however, to the condition that no cut-off shall be undertaken until the necessary right of way therefor shall have been provided without cost to the United States.

I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore in carrying out the instructions of Congress I report as follows: That the improvement by the United States of Mispillion River, Del., is deemed advisable so far as to secure an available mean low-water depth of 6 feet throughout from Delaware Bay to the town of Milford and width of 60 feet in the river except through the five cut-offs, which are to be dredged only 50 feet wide, and with a width of 80 feet across the flats instead of 150 feet as at present projected; also the extension of the existing south jetty 750 feet, at an estimated cost of \$70,400 for first construction and \$5,000 annually for maintenance, subject, however, to the condition that no cut-off shall be undertaken until the necessary right of way therefor shall have been provided free of cost to the United States.

SMYRNA RIVER, DEL.

Location and description.—This river, a tidal stream, formerly Duck Creek, rises on the Maryland-Delaware divide, forms a part of the boundary line between New Castle and Kent Counties, flows in a northeasterly direction, and empties into the Delaware Bay about 57 miles below Philadelphia, Pa.

Existing project.—This project was adopted by the river and harbor act of June 25, 1910, and provides for dredging the channel from Smyrna Landing to the mouth 7 feet deep at mean low water and 60 feet wide and 100 feet wide across the bar outside of the mouth; also three cut-offs and the permanent protection of the channel across the bar by jetties; estimated cost, \$89,000. (H. Doc. No. 815, 60th Cong., 1st sess., with map.) The mean range of tide at the mouth was 6 feet, at Flemmings Landing 4.2 feet, and at Smyrna Landing $3\frac{1}{2}$ feet. The section included in the project extends from the Delaware Bay to Smyrna Landing, a distance of 10 miles.

Condition at the end of fiscal year.—This is a new project, just started, and at the close of the fiscal year 5 per cent of the project had been completed. The minimum usable depth June 30, 1916, between Delaware Bay and Smyrna Landing was 4 feet. The total expenditures under the existing project to June 30, 1916, was \$747.09, all of which was for new work.

Local cooperation.—As required by law the land required for the necessary cut-offs was transferred to the United States free of cost, and the title was approved by the Chief of Engineers December 11, 1915.

Effect of improvement.—The improvement has not advanced far enough as yet to be a benefit to navigation.

Proposed operations.—The funds available are being expended under contract in dredging operations to project dimensions, and

will be used in continuing the dredging operations toward completion of that portion of the project. It is proposed to apply the funds estimated for the fiscal year ending June 30, 1918, in starting operations of constructing a portion of the south jetty at the mouth. The length constructed will be dependent upon the price bid for the work. It is estimated that at least 1,000 feet can be constructed with this amount.

Commercial statistics.—The general character of the commerce for the current year was coal, fertilizer, hay, cattle, canned goods, dairy products, agricultural products, and general merchandise.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	117,786	\$1,067,750.00
1914.....	20,216	299,451.74
1915.....	18,580	470,418.32

It is believed that this statement of commerce may not fully represent all the actual commerce transported on this stream during the year 1915.

Amount expended on all projects from June 18, 1878, to June 30, 1916:

New work.....	\$55,831.87
Maintenance.....	22,722.85
Total.....	<u>78,554.72</u>

Amount (estimated) required to be appropriated for completion of existing project.....	59,000.00
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement.....	20,000.00
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BROADKILL RIVER, DEL.

Location.—This river, a tidal stream, rises in and flows northeasterly through Sussex County and empties into Delaware Bay about 5 miles above Cape Henlopen. The navigable length of the stream is about 11 miles.

Existing project.—This project was adopted by the river and harbor act of March 2, 1907, and provides for the establishment of a permanent entrance by dredging a channel through Lewes Cape 6 feet deep and 150 feet wide, from that depth in Delaware Bay to the same depth in Broadkill River, and the construction of a jetty on the north side of the entrance; estimated cost, \$33,300. (H. Doc. No. 214, 59th Cong., 2d sess., with map.) The mean range of tide at the mouth is $4\frac{1}{2}$ feet, and at Milton, $3\frac{1}{2}$ feet. The section included in the project is the new entrance cut across Lewes Cape, connecting deep water inside with that outside, about a half mile in length.

Condition at the end of fiscal year.—The project has been completed. Minimum usable depth June 30, 1916, through the new entrance was $2\frac{1}{2}$ feet, and in the river 5 feet. The amount expended to the close of the fiscal year 1916, under the existing project, was \$33,197.97 for new work, and \$31,138.11 for maintenance, a total of \$64,336.08. The project was completed at a saving of \$102.03.

Local cooperation.—The land required for the new entrance was furnished voluntarily free of cost to the United States by the owner of the tract through which the new entrance was cut. Title to the land was approved by the Department of Justice, June 21, 1907.

Effect of improvement.—It has facilitated vessel movement by shortening the distance to the head of navigation 2 miles and by providing a permanent increased depth at the entrance.

Proposed operations.—Provision has been made to apply the funds available to the restoration and maintenance of the jetty, which has deteriorated to a considerable extent. These funds will not be sufficient to complete the work of restoration throughout the entire length of the jetty, and it is proposed to apply the funds estimated for the fiscal year ending June 30, 1918, in continuing this work to completion by placing stone to the amount of about 3,000 cubic yards in the jetty where the filling has settled.

Commercial statistics.—The general character of the commerce for the current year was coal, fertilizer, piling, lumber, canned goods, agricultural products, and general merchandise.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	(1)	(1)
1914.....	172	\$2,453
1915.....	5,879	91,915

¹ No statement obtained.

Amount expended on all projects from June 10, 1872, to June 30, 1916:

New York.....	\$68,227.97
Maintenance	31,138.11
Total	99,366.08

July 1, 1916, balance unexpended.....	9,596.59
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	10,000.00

INLAND WATERWAY BETWEEN REHOBOTH BAY AND DELAWARE BAY, DEL.

Location and description.—This tidal canal, situated in the southeasterly part of Sussex County, extends from Rehoboth Bay northward through the highland west of the town of Rehoboth Beach to Gordon Lake, thence through the marshes back of Cape Henlopen to Lewes River, it then follows the latter and Broadkill River, emptying into the Delaware Bay about 5 miles above Cape Henlopen.

Existing project.—This project was adopted by the river and harbor act of July 25, 1912, and provides for a canal 6 feet deep at mean low water, 50 feet wide through Lewes River and the marshes, and 40 feet wide where it passes through deep cutting, including also the construction of two bridges. Estimated cost \$356,000, which includes \$14,275 for the purchase of land, since obtained free of cost to the United States, making the actual estimated cost to the United States \$341,725. Estimated annual cost of maintenance, \$7,500.

(H. Doc. No. 823, 60th Cong., 1st sess., with map, and Rivers and Harbors Committee Doc. No. 51, 61st Cong., 3d sess.) The mean range of tide at the mouth of Broadkill River is $4\frac{1}{2}$ feet and at Lewes 3 feet. The section included in the project is about 12 miles.

Condition at the end of fiscal year.—About 44 per cent of the project has been completed. A channel 5 feet deep and from 35 to 50 feet in width extends from a point 11,300 feet below Ocean House Bridge (removed) in the town of Lewes, southward through Lewes River, and across the marshes to within about 450 feet of the railroad crossing at Rehoboth, a distance of 8.2 miles. Between the lower limit of the improvement and Delaware Bay at the mouth of Broadkill River there was a minimum usable depth of $2\frac{1}{2}$ feet. From the southern limit of the improvement at present to connection with the waters of Rehoboth Bay there remains a length of about 1,000 feet of highland excavation. The amount expended to the close of the fiscal year ending June 30, 1916, was \$150,125.70, all of which was for new work.

Local cooperation.—As required by law, the land required for cut-offs and for right of way for the canal from Lewes River southward was furnished free of cost to the United States by the State of Delaware and interested parties, with the exception of the railroad crossing at Rehoboth. The titles were approved by the Department of Justice November 3, 1892, and May 3, 1913.

Effect of improvement.—The improvement has not progressed sufficiently to have any appreciable effect on commerce.

Proposed operations.—The funds available are being expended in continuing the excavation between Gordon Lake and the railroad crossing, and upon the completion of this work, as the railroad bridge has been finished, any balance remaining will be applied to the excavation through the railroad bridge to connect with the canal excavated several years ago from Rehoboth Bay northward and in extending the waterway from the present northern terminus of the improvement to the junction of Lewes River with the Broadkill River, a distance of about 1 mile, and in enlarging, as far as the funds will permit, the cross section of the waterway to project dimensions between Broadkill River and Rehoboth Bay. It is proposed to apply the funds estimated for the fiscal year ending June 30, 1918, in extending the improvement by excavation to project dimensions toward completion and in restoring the jetties at the Rehoboth end of canal.

Commercial statistics.—The general character of the commerce for the current year was farm produce, machinery, phosphate, cordwood, piling, mine props, coal, lobsters, crabs, fish, canned goods, and general merchandise.

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	(1)	(1)
1914.....	4,928	\$67,122.60
1915.....	13,655	303,239.00

¹ No statement obtained.

Amount expended on all projects from 1886 to June 30, 1916, new work-----	\$150, 125. 70
Balance available for fiscal year ending June 30, 1917-----	65, 181. 30
Amount (estimated) required to be appropriated for completion of existing project-----	115, 000. 00
<hr/>	
Amount that can be profitably expended in fiscal year ending June 30, 1918:	
For works of improvement-----	40, 000. 00
For maintenance of improvement-----	10, 000. 00
<hr/>	
Total-----	50, 000. 00

INLAND WATERWAY FROM CHINCOTEAGUE BAY, VA., TO DELAWARE BAY, AT OR NEAR LEWES, DEL.

Location and description.—This waterway was to extend from Chinocoteague Bay, Va., northward, following the waterways parallel with the ocean, through Virginia, Maryland, and Delaware, cutting the neck of land at Ocean View, Del., and the land between Rehoboth Bay and the headquarters of Lewes River, entering the Delaware Bay opposite the town of Lewes, a distance of about 70 miles.

Existing project.—This project, adopted in the river and harbor act of August 5, 1886 (Annual Report for 1885, pp. 891–905), provides for a waterway 6 feet deep and 70 feet wide from Chincoteague Bay, Va., to Delaware Bay at or near Lewes, Del., a distance of about 70 miles, at an estimated cost of \$350,000. The project was modified in 1892 for the section between Rehoboth and Delaware Bay, a distance of 8 miles, reducing the width to 20 feet on bottom, with turnouts 70 feet wide every mile. The river and harbor act of March 3, 1905, repealed the project. The river and harbor act of 1910 revived the project in so far as the restoration and maintenance of the three Government-built bridges at Ocean View, Del., were concerned. (See H. Doc. No. 538, 59th Cong., 1st sess., with map.)

Condition at the end of fiscal year.—The project was about one-third completed when repealed in 1905, and no extension of the work under this project has been made since. The appropriation of \$1,500 in the river and harbor act of June 25, 1910, and two subsequent allotments of \$1,000 each have been applied to the maintenance of the Government-built bridges at Ocean View. The project for an inland waterway between Rehoboth Bay and Delaware Bay, Del., adopted by the river and harbor act of July 25, 1912, follows practically a portion of the line included in the project for the waterway between Chincoteague Bay, Va., and Delaware Bay, Del., and the completion of the former will accomplish the purpose of the Chincoteague-Delaware Bay project in connecting the intracoastal waterways of the Delmarvia Peninsula or the lower waters with Delaware Bay. Combining the work done under the two projects, the improvement of the waterway between Chincoteague Bay, Va., and Delaware Bay, Del., according to the plan of the earlier project, was about 45 per cent completed at the end of the last fiscal year.

Local cooperation.—The land necessary for the cuts through high land between Assawoman Bay and Indian River Bay and between Rehoboth Bay and Delaware Bay was furnished free of cost to the United States by the State of Delaware. Title thereto was approved by the Department of Justice July 2, 1888, and November 3, 1892, respectively.

Effect of improvement.—The canal is used to a constantly growing extent even in its uncompleted condition. Considerable traffic in farm produce, timber, piling, and general merchandise is being carried on among the landings and settlements along the waterways and from the railroad connections at Millsborough and Rehoboth.

Proposed operations.—Although the three Government-built bridges at Ocean View, Del., are believed to be in good condition, the frequency of repairs is increasing with the increase of vehicle traffic over them. It is proposed to apply the funds now available and those estimated for the fiscal year ending June 30, 1918, in general repairs, as found necessary, and in maintenance.

Commercial statistics.—The general character of the commerce for the current year was timber, tomatoes, strawberries, farm produce, coal, lime, oyster shells, canned goods, and general merchandise.

Comparative statement.

BETWEEN ISLE OF WIGHT BAY AND REHOBOTH BAY, DEL.

Fiscal year.	Short tons.	Value.
1913.....	(1)	(1)
1914.....	(1)	(1)
1915.....	10,601	\$247,568.96

¹ No statement obtained.

Amount expended on all projects from Aug. 5, 1886, to June 30, 1916:

New work.....	\$168,411.88
Maintenance	27,988.59
Total.....	196,400.47

July 1, 1916, balance unexpended.....	841.83
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	1,000.00

INLAND WATERWAY FROM DELAWARE RIVER TO CHESAPEAKE BAY THROUGH CHESAPEAKE & DELAWARE CANAL—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 196, Sixty-third Congress, first session:

A first and partial report upon this waterway, including maps and estimate of cost, was forwarded by me on January 2, 1912 (printed in H. Doc. No. 391, 62d Cong., 2d sess.), in which recommendations were made (a) in favor of an immediate improvement of the section from Beaufort, N. C., to Norfolk, Va.; (b) in favor of the immediate purchase of the existing canal between Chesapeake Bay and Delaware River and its early enlargement to about 12 feet depth and appropriate width, leaving to a subsequent report (the present) the question of further deepening; (c) a postponement to a subsequent report (the present) of the question of what should be done between Delaware River and New York Harbor; (d) a postponement to a subsequent report (submitted Aug. 7, 1913, and now before Congress) of the through route between New York Bay and Fishers Island; and (e) unfavorably and against, under present physical and commercial conditions, any construction by the Federal Government of any inland route between Fishers Island and Boston, Mass., other than what had already been authorized by past river and harbor acts. This present and final report is therefore confined to the unfinished matters under headings (b) and (c), as stated above, as to which the special board has submitted a special

report, dated February 14, 1912 (copy attached), duly considered and reviewed by the Board of Engineers for Rivers and Harbors in its report of July 22, 1912 (copy attached). After due consideration of these two additional reports, in connection with the original reports, this office submits its own comments and recommendations as follows:

Regarding the further improvement of the already recommended waterway between Chesapeake Bay and Delaware Bay, the Chief of Engineers concurs with both the special board and Board of Engineers for Rivers and Harbors in the opinion that it is advisable for the United States to buy the Chesapeake & Delaware Canal at a cost to the United States not exceeding \$2,514,290 and to then enlarge it to a sea-level canal of 12 feet depth and 90 feet bottom width, with the least interference practicable to existing traffic, following, in general, the methods indicated by the special board, at a cost which, including the first year's maintenance, amounts in round numbers to \$8,000,000, of which \$3,000,000 should be made available by the first appropriation, and economical work will then require subsequent appropriations of from \$500,000 to \$1,000,000 per year.

The Chief of Engineers concurs with the Board of Engineers for Rivers and Harbors in the view that further deepening to 25 feet of the Chesapeake & Delaware Canal at an extra cost of \$4,500,000 should await further observation as to the commercial changes resulting from the first increase in canal depth and especially the release from canal tolls. Moreover, the Chief of Engineers is of the opinion that the general public benefit will be that due to the increase of commerce by use of barges in tows and of medium-draft boats; and that the added benefits accruing from heavy-draft boats will be mainly local and consequently should await cooperation by the local States or those most directly benefited. As the work to be done is progressive, as under present Federal laws, the Engineer Department can always receive and expend local funds for such purposes, it will always be possible to increase the project depth above 12 feet up to 25 feet as fast as local cooperation furnishes the funds.

Following are extracts from Senate Document 215, Fifty-ninth Congress, second session:

WAR DEPARTMENT,
Washington, January 12, 1907.

SIR: In conformity with the requirements of joint resolution No. 37, approved June 28, 1906 (Pamphlet laws, 59th Cong., 1st sess., p. 835), I have the honor to transmit herewith the report, dated January 1, 1907, of the commission appointed by the President of the United States to examine and report upon a route for the construction of a free and open waterway to connect the waters of the Chesapeake and Delaware Bays, with accompanying maps.

In view of the value of the report to commercial interests, it is respectfully suggested that the report, with illustrations, be printed in its entirety.

A like copy of the report, with accompanying maps, has to-day been transmitted to the Speaker of the House of Representatives in conformity to the resolution of the Congress.

Very respectfully,

WM. H. TAFT, *Secretary of War.*

THE PRESIDENT OF THE UNITED STATES SENATE.

BALTIMORE, MD., *January 1, 1907.*

SIR: This commission was authorized by public resolution No. 37 (Appendix A) of the Fifty-ninth Congress to "examine and appraise the value of the works and franchises of the Chesapeake & Delaware Canal, connecting the waters of the Chesapeake and Delaware Bays, with reference to the desirability of purchasing the said canal by the United States and the construction over the route of the said canal of a free and open waterway having a depth and capacity sufficient to accommodate the largest vessel afloat at mean low water," and also "to the extent that the same can be done from the surveys heretofore made under the direction of the War Department and within the limits of the appropriation herein made" to "examine and investigate the feasibility, for the purpose of such a waterway, of the route known as the Sassafras route." The commission was ordered to "make a report of its work, together with its conclusions upon the probable cost and the commercial advantages and the military and naval uses of each of the said routes, to the Secretary of War, who shall transmit the same to Congress at its next session." In accordance with these instructions

the commission has the honor to submit its conclusions, and, following them, its full report:

CONCLUSIONS.

1. *Appraisalment of the Chesapeake & Delaware Canal.*—The commission believes that no higher value than \$2,514,289.70 should be paid by the Government for the works, franchises, bonds, real property, holdings, and all other claims of the Chesapeake & Delaware Canal Co., except certain outside holdings which have been deducted.

2. *The desirability of purchasing said canal and the construction over the route of a free ship canal.*—The commission believes the purchase of the present canal to be desirable and the construction over the route of a free ship canal to be justified by the demands of commerce and by military and naval considerations.

3. *The feasibility of the Sassafras route.*—The commission finds this route entirely feasible, but more costly than the Chesapeake & Delaware Canal or Back Creek route.

4. *The cost of a canal on the Sassafras route.*—The probable cost of a canal on the Sassafras route would be \$23,071.864 by the Blackbird, or \$21,143.470 by the Appoquinimink.

5. *The commercial advantages.*—The commercial advantages would be practically the same by both the Sassafras and the Chesapeake & Delaware routes.

6. *Military and naval uses of each of said routes.*—They would be identical, except that the selection of the Sassafras route would necessitate the removal of the present defenses of the Delaware, entailing an expense of \$2,150,000.

7. *The selection of route.*—The commission believes the present Chesapeake & Delaware Canal route to be better, because for a ship canal it would be cheaper; because it offers equal commercial advantages; because, being defended, it has an additional advantage of cost of \$2,150,000; because it has fewer bridges; and because it is a developed property possessing earning capacity.

THE REPORT.

The commission was organized at a meeting in Baltimore on July 30, 1906, Gen. Felix Agnus being elected chairman and L. R. Meekins appointed clerk to the commission. Meetings were held from time to time as required by current business. Public hearings were also conducted at Baltimore, Wilmington, and Philadelphia.

In accordance with the terms of the resolution the commission made use of former surveys, and examined and investigated the Sassafras route. Much of the data was found in previous congressional publications, but Executive Document No. 102, of the Fifty-third Congress, third session, contained a résumé of practically all previous papers on this subject. (The parts of this document pertinent to the commission's work will be found in Appendix G.) The commission, however, considered that as the terms of the resolution called for a much deeper channel than heretofore proposed, and as certain of the previous borings to determine the character of the excavated material gave unfavorable results, additional field work would be necessary. (See Appendix C.)

THE APPRAISAL OF THE CHESAPEAKE & DELAWARE CANAL.

In the appraisal of the works of the Chesapeake & Delaware Canal the canal company was called upon to furnish detailed bills of inventory of its property, with itemized valuation, but repeated requests failed to secure any but the most insufficient and almost totally useless figures. If there are any records of surveys showing the original profile of the canal route, or of the canal in detail as it now exists, the commission has not been able to secure them. To make such surveys would consume more time and money than are available, and in view of the fact that it is well-nigh impossible to separately evaluate "the works and franchises," the latter being practically inseparable from the former, expensive surveys in this connection would prove unjustifiable. The commission has, however, considered the value of the works and franchises in every way (see Appendix B), and it states as its appraised "value of the works and franchises of the Chesapeake & Delaware Canal," \$2,514,289.70.

THE COMMERCIAL ADVANTAGES.

Thus far the routes have been considered separately. The remaining points should be considered together, the military, naval, and commercial uses being either identical for the two or directly comparable.

In the commercial sense the difference between the two routes is so slight as to be inconsiderable when other items, such as engineering features, cost, or effects upon existing interests are taken into account. The present Chesapeake & Delaware route is slightly shorter to Philadelphia, the Sassafras to the mouth of the Delaware,

The distance from Baltimore to Philadelphia will be shortened by 323 miles, from Baltimore to the mouth of the Delaware Bay by 184 miles. Vessels can proceed from Baltimore to the mouth of the Delaware with full protection in weather when it would be hazardous to venture into the open sea.

The projected canal across the Maryland-Delaware Peninsula would unquestionably be a great convenience to foreign shipping. The view that it would not be used by ocean-going ships is the same contention that arose when the other great ship canals were built, but their history has shown that when the channel is cut the ships will always take the shortest course.

The Delaware and Chesapeake Bays have a shore line of 2,500 miles, with 500 tributary streams and more than 10,000 registered vessels.

An idea of the trade immediately affected can be had from the statement contained in report No. 2725 to the Fifty-eighth Congress, which says:

"The commerce of the Delaware and Chesapeake, registered and otherwise, has been estimated all the way from 50,000,000 to 90,000,000 tons annually. This is much larger than the tonnage of the entire annual foreign commerce of the United States. The Isthmian Canal Commission estimated that the Panama Canal, now to be built at a cost approximating \$200,000,000, would have carried a tonnage in 1899 of but 4,574,852 tons."

Of the registered tonnage traffic in a recent compilation, 25,873,167 were on Delaware Bay points and 24,151,932 on Chesapeake Bay points. These figures, however, do not include the undocumented and unregistered tonnage traffic, which would add nearly 100 per cent to the total.

Considerably less than one-tenth of the traffic on the Delaware and Chesapeake Bays and their various points belongs to foreign commerce. The great value of the proposed canal would be in facilitating the coastwise trade.

MILITARY AND NAVAL USES.

In a general strategic sense the military advantages of the proposed ship canal appear most prominently in the channel offered for the rapid transit of naval vessels from one bay to the other to concentrate against hostile naval fleets or for the breaking of blockades.

To make the canal thus available at all times, its termini must be thoroughly protected by sufficient coast defenses to render its passage at all times open. This is at present secured on the Delaware for the Chesapeake & Delaware Canal route by existing defenses and on the Chesapeake by the defenses of Washington, Baltimore, and Hampton Roads, which an attacking naval force would hesitate to leave in its rear, sheltering cruisers that could demolish its boats of communication and supply. But full strategic use of the canal could be secured only by adequate coast defense at each terminus. It is not considered that a project for the defense of the Chesapeake terminus lies within the scope of this report, as such project should receive careful consideration by a competent board of military engineers. The cost would be practically the same for either route.

Assuming, however, that both termini are to be properly defended the canal itself offers many advantages to such defense by the ready means of intercommunication afforded. The canal would permit the prompt interchange of troops and munitions between the coast batteries and particularly of the submarines, scout boats, and coast-defense monitors that now form an important factor in seacoast defense, thus minimizing the number required for a complete defense.

Another important feature of the canal would be the obstacle presented by it as an adjunct for land defenses. These would serve as a base for troops operating to break up military occupation of the peninsular or to check advances therefrom, without reembarkation should such occupation become effective. A geographical study of the Atlantic coast of the United States, as at present defended, shows the peninsula of Maryland and Delaware as the most vulnerable and suitable place for the location of a base for land operations should our Navy be driven from the seas. This was demonstrated by history in the War of 1812. (Appendix E.)

The line of the canal properly defended would also prevent the closing of land communications to the coast forts on the Delaware, in case their reduc-

tion by siege should be attempted, with the view to opening the way for a naval advance on Philadelphia. Should the proposed Sassafra route be selected for the route of the canal, additional defenses would be required on the Delaware to protect the entrance and prevent distant bombardment of vessels in the canal. Such defense would require the expenditure of over \$2,000,000 for the abandonment of the present defenses of the Delaware and their reestablishment at a point farther down the river, probably in the vicinity of Listons Point, this estimate being obtained as follows:

Construction of new batteries and accessories-----	\$1, 220, 000
Construction of new barracks and post buildings-----	760, 000
Transfer of armament-----	100, 000
Purchase of land, 500 acres, at \$250-----	125, 000
Total -----	2, 205, 000
Deduct sale value present reservations, 550 acres, at \$100-----	55, 000
Net balance -----	2, 150, 000

The Civil War developed the enormous value of the present canal as a means of transportation of troops, supplies, and prisoners. While our railroad facilities have greatly increased since that time, it is easily conceivable that in future wars or internal disturbances the proposed ship canal would very likely prove an important adjunct to rail transportation and possibly a vital factor in campaigns, should rail transportation be interrupted by accidents, strikes, or hostile raids.

The experts of the present Naval General Board would be satisfied for the canal to pass vessels of 16-foot draft and 60-foot beam; in other words, monitors, torpedo boats, and destroyers. The commission fully agrees that the principal naval uses of the proposed canal would probably be as stated and is inclined to think that for present purposes a canal of 30-foot or perhaps of even 27-foot draft would be ample. It further believes that just as many battleships will be required with as without the canal, as it would plainly not be within the province of the heaviest of the fighting units to remain in harbor entrances for local defenses.

However, it is the opinion of the commission that the experts look too much to victory and ignore such conditions as defeat or at least heavy punishment in battle. While the General Board of the Navy may not recognize the probability of transference of the battle fleet as a whole through the Chesapeake & Delaware Canal, it is not difficult to conceive of that fleet, badly crippled in a general engagement at sea, limping home in detail to be divided for repairs among several such navy yards as Norfolk, League Island, and New York. When repairs are finished the safer and better way to assemble would be by way of the ship canal, either to the Delaware or the Chesapeake.

BALTIMORE HARBOR, MD.

Location and description.—The Patapsco River is formed by the North and South Branches of Patapsco River, both of which rise in the central part of Maryland. It flows southeasterly for about 65 miles and empties into Chesapeake Bay 11 miles below the city of Baltimore. For a short distance above Baltimore it is tidal. The improved portion of the river lies in and below the city of Baltimore.

Existing project.—This is to obtain a channel 35 feet deep and 1,000 feet wide at mean low water between the 35-foot contours in Chesapeake Bay opposite York Spit and a channel 35 feet deep and 600 feet wide from the 35-foot contour in Chesapeake Bay below the mouth of Patapsco River to and in that river as far as Fort McHenry, with an anchorage basin 35 feet deep, 600 feet wide, and 3,500 feet long near the intersection of the Fort McHenry and Curtis Bay Channels. The estimate of cost of the work was \$3,770,250. The mean range of tide is a little over 1 foot in the Patapsco and about 2½ feet in the York Spit section. The York Spit Channel is a detached section 4½ miles long in the lower bay, opposite mouth of

York River, 158 miles from the Patapsco, and the upper channel is 9 miles long from the 35-foot contour in Chesapeake Bay to the mouth of the Patapsco and 11 miles long in that river.

The project stated above was adopted by parts, as follows: A 35-foot channel 600 feet wide throughout, at an estimated cost of \$3,465,000, no estimate for maintenance being included (H. Doc. No. 186, 57th Cong., 2d sess.), by the river and harbor act of March 3, 1905; an increase in width of the York Spit Channel from 600 feet to 1,000 feet, at an estimated cost of \$305,250 and \$20,000 annually for maintenance (H. Doc. No. 1190, 62d Cong., 3d sess., with map), by the river and harbor act of March 4, 1913; the anchorage basin near the intersection of the Fort McHenry and Curtis Bay Channels upon the condition that such addition could be made within the original limit of cost (no prior estimate or recommendation was made by the War Department for this addition), by the river and harbor act of March 3, 1909; an increase of channel width at the entrances and bends, provided such increase could be made within the limit of the original estimate, by the river and harbor act of February 27, 1911.

Condition at the end of fiscal year.—The improvement has been completed and maintained in good condition by dredging under the existing project. The controlling depth at mean low water is 35 feet. Total expenditures under existing project are \$3,441,050.56 for new work and \$266,544.58 for maintenance, making a total of \$3,707,595.14. The project was completed during the fiscal year 1915 for \$329,199.44 less than the estimate.

Local cooperation.—Congress has never prescribed any conditions as to local cooperation, but the State of Maryland and city of Baltimore, chiefly the latter, have at various times in the past expended about \$750,000 on the improvement. In addition, the city has expended nearly \$12,000,000 in dredging the inner harbor to connect with the upper end of the 35-foot channel made by the United States, in the construction of municipal wharves and in other works.

Effect of improvement.—Because of disturbed shipping conditions, due to the European war, it is impossible to determine what effect the improvement will have on freight rates under normal conditions. The city of Baltimore is about completing certain portions in the harbor to a depth of 35 feet so as to fully conform to the improvement already made by the Government.

Proposed operations.—It is proposed to expend a portion of the funds available under contract now in force for redredging in the Craighill-Cutoff angle. With funds asked for it is proposed to do maintenance dredging to the amount of 152,000 cubic yards in the Fort McHenry section, 171,000 cubic yards in the Fort McHenry Brewerton angle, and 312,000 cubic yards in the cut-off section; all of which was found by recent examination to exist. The shoaling of these channels have been gradual, over a period of several years, and as the city of Baltimore is about completing the dredging of the inner harbor to 35 feet depth, it is thought advisable to redredge these sections to full project depth.

Commercial statistics.—The general character of the commerce for the current year consisted of coal, coke, grain, iron, oysters, lumber, etc. A new line of steamers was established between Baltimore and Manchester, England.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	14,781,548	\$439,906,468
1914.....	13,425,185	383,401,736
1915.....	15,762,942	452,040,202

Amount expended on all projects from July 4, 1836, to June 30.

1916:	
New work.....	\$8,217,320.04
Maintenance.....	266,544.58
Total.....	8,483,864.62
July 1, 1916, balance available.....	36,947.06
Amount that can be profitably expended in fiscal year ending	
June 20, 1918, for maintenance of improvement.....	104,000.00

BALTIMORE HARBOR, MD., AND APPROACHES—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 799, Sixty-fourth Congress, first session.

Under existing projects for improvement of Baltimore Harbor, all of which have been completed, the United States has provided, first, a channel 35 feet deep at mean low water from the sea to the city line at Fort McHenry, 1,000 feet wide through the shoal opposite York Spit and 600 feet wide from the 35-foot contour in Chesapeake Bay to Fort McHenry, with an anchorage basin 3,500 feet long and 600 feet wide about 3.5 miles below the upper end of the project; second, a channel 30 feet deep and 250 feet wide from the 35-foot channel in the Patapsco River for a distance of about 2.2 miles to a point near the coal piers in Curtis Bay, with a turning basin at the upper end; third, a channel 100 feet wide and 27 feet deep at mean low water from the 35-foot channel near Fort McHenry through the Patapsco River and Middle Branch (Spring Garden) to near the foot of Eutaw Street, with a turning basin 400 feet by 400 feet near the upper end. The total amount expended on these channels to June 30, 1915, is \$9,098,040.68. The city of Baltimore has contributed somewhat toward the provision of the approach channels, and it has hitherto assumed the entire cost of work in the inner harbor above Fort McHenry, where it is now dredging to a depth of 35 feet over a certain area. The district officer recommends that the United States assume the maintenance of this depth in the inner harbor after it has been provided by the city. He states that all the work by the Government in the Patapsco and its tributaries should be embraced under one project for Baltimore Harbor, and for reasons stated he believes that the anchorage area should be enlarged and all the channels should have a depth of 35 feet, except the upper portion of the channel to Southwest Baltimore above Ferry Bar, where he proposes a depth of 27 feet, increasing the width, however, to 250 feet. He recommends that the project be stated as follows:

“For a channel 35 feet deep and 1,000 feet wide between the curves of 35 feet depth in Chesapeake Bay opposite York Spit; 35 feet deep and 600 feet wide from the 35-foot curve below the mouth of the Patapsco River, to and in that river as far as Fort McHenry, with a branch channel 35 feet deep and 250 feet wide into Curtis Bay to head of bay, and one 35 feet deep and 400 feet wide into the Southwest Branch of the Patapsco River to a point near Ferry Bar and 27 feet deep and 250 wide to the Western Maryland Railway bridge, widened at the approaches and bends, and with anchorage and turning basins, as shown approximately on the map accompany this report.”

The additional work involved in the above-recommended project is estimated to cost \$876,100, with \$34,000 for annual maintenance of the entire improvement. The division engineer concurs in the views of the district officer.

I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that it is deemed advisable to combine into one project for Baltimore Harbor the sev-

eral existing channels of Patapsco River and its tributaries and approaches, with the additional work recommended by the district officer, as specified above and shown on accompanying map, at an estimated cost of \$876,100, of which \$123,700 is for Curtis Bay Channel, already recommended in House Document No. 7, Sixty-third Congress, first session. The estimated cost of maintenance is \$34,000 annually. It is recommended that, with the exception of the Curtis Bay Channel, the work of improvement by the United States be made conditional upon local interests providing, free of cost to the United States, whenever required by the Chief of Engineers, suitable areas behind bulkheads or other revetment, satisfactory to the district engineer officer, in which the dredged material may be deposited; and it is further recommended that as rapidly as the city of Baltimore, at its own expense, extends the 35-foot depth into the inner harbor or basin inside of Fort McHenry the United States take over the maintenance of such extension. The cost of this maintenance work is not now known, but will be included if authorized in the annual estimates for maintenance of Baltimore Harbor.

QUEENSTOWN HARBOR.

Location and description.—This harbor is about one-half mile square, and is located on the eastern shore of Chesapeake Bay, being an arm of Chester River, about 35 miles southeast of Baltimore Harbor.

Existing project.—This was adopted by the river and harbor act of June 13, 1902, and is to dredge a channel 10 feet deep and 200 feet wide at mean low water from that depth in Chester River to the 10-foot contour in the inner harbor, at an estimated cost of \$23,100, subsequently increased to \$25,886.35. No estimate for maintenance. (H. Doc. No. 92, 56th Cong., 1st sess., with map.) The mean range of tide is about 2 feet. The length of the section included in the project is about 1 mile.

Condition at the end of fiscal year.—The improvement has been completed and maintained in good condition by dredging under existing project. The controlling depth at mean low water is 9½ feet. Total expenditures on existing project were \$25,858.27 for new work and \$18,399.75 for maintenance, making a total of \$44,258.02. The project was completed in the fiscal year 1911.

Effect of improvement.—The improvement has made no appreciable difference in freight rates so far, but has rendered navigation to and from the inner harbor easier and safer.

Proposed operations.—It is proposed to expend funds asked for in removing shoals which were found by recent examination to have formed within the project limits, requiring the removal of 15,500 cubic yards of material.

Commercial statistics.—The general character of the commerce for the calendar year 1915 consisted of agricultural products, canned goods, coal, fish and oysters, and general merchandise.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	28,335	\$1,307,806
1914.....	21,737	1,067,935
1915.....	18,670	323,907

Amount expended on all projects from Mar. 3, 1871, to June 30, 1916:

New work	\$44,858.27
Maintenance	18,399.75
Total	63,258.02

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement 3,000.00

CLAIBORNE HARBOR.

Location and description.—This harbor is about one-half mile square and is located on the eastern side of Eastern Bay, a tributary of Chesapeake Bay, about 42 miles southeast of Baltimore Harbor. It is protected somewhat from the currents from Eastern Bay around Tilghman Point by a short jetty.

Existing project.—This was adopted by the river and harbor act of June 13, 1902, and is to dredge a channel 12 feet deep and 300 feet wide at mean low water from the 12-foot contour in Eastern Bay to the railroad pier in the harbor, and thence shoreward along the south side of the pier to a width of 195 feet for a length of 500 feet, and an extension of the existing jetty, at an estimated cost of \$17,490 and \$2,500, respectively—a total of \$19,990 for the entire project. No estimate for maintenance. (H. Doc. No. 81, 56th Cong., 1st sess., with map.) The estimate for dredging was later increased to \$27,408.30, making a total for the entire project of \$29,908.30. The mean range of the tide is about 2 feet. The length of all improved sections is about 2,400 feet and of the jetty 253 feet.

Condition at end of fiscal year.—The channel portion of the improvement has been completed and maintained in good condition by dredging. The jetty or breakwater has also been completed. The controlling depth at mean low water is 11½ feet. The total expenditures on existing project were: Dredging, \$27,373.65; jetty construction, \$2,500; total for new work, \$29,873.65; for maintenance, \$26,972.44; making a total of \$56,846.09. The channel portion of the project was completed in the fiscal year 1911 and the jetty portion in 1912.

Effect of improvement.—The improvement has made no appreciable difference in freight rates, but is the terminus of both the water and land lines of the Baltimore, Chesapeake & Atlantic Railway Co.

Proposed operations.—Available funds will be expended in repairing the existing jetty by replacing sheet piling and depositing riprap, and in removing a portion of shoaling amounting to 32,000 cubic yards which a recent examination developed. It is thought the jetty work will be completed in a couple of months. Available funds will be exhausted by June 30, 1917. It is proposed to expend funds asked for in removing the remainder of the existing shoaling and additional shoaling which experience since 1908 shows has amounted to about 10,000 cubic yards per year.

Commercial statistics.—The general character of the commerce for the calendar year 1915 consisted of agricultural products, canned goods, coal, general merchandise, lumber, etc.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	107,564	\$9,075,385
1914.....	25,726	1,909,839
1915.....	21,300	1,502,780

The decreased tonnage reported for 1914 and 1915 compared with that for 1913 is due to the lesser amounts reported in the later years by the Baltimore, Chesapeake & Atlantic Railway Co., which reported 21,406 tons for 1914, 18,675 tons for 1915, and 107,097 tons for 1913.

The reports of the railway company were doubtless in error as to 1913 commerce, although by what amount can not be stated. Nevertheless, there has been a considerable diminution of commerce. The company explains that since 1913 there has been a decrease of tonnage due to the discontinuance of business of several oyster packing houses and the further fact that it now handles by land routes a large tonnage of railroad ties, lumber, and coal, which it formerly handled by barges and sailing vessels.

Amount expended on all projects from June 13, 1902, to June 30, 1916:

New work	\$29,873.65
Maintenance	26,972.44
Total.....	<u>56,846.09</u>

Balance available for fiscal year ending June 30, 1917..... 3,500.00

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 6,000.00

TYASKIN CREEK.

Location and description.—This creek, also known as Wetipquin Creek or River, has its source in Wicomico County, Md., and flows in a generally westerly direction, emptying into Nanticoke River. Its length is about 5 miles. This stream is practically all tidal, its natural flow being insignificant.

Existing project.—This was adopted by the river and harbor act of March 2, 1907, and provides for dredging a channel 9 feet deep at mean low water and 120 feet wide from the 9-foot contour in Nanticoke River to the wharf at Tyaskin, with a suitable turning basin at the upper end, at an estimated cost of \$6,462.39; no estimate for maintenance. (H. Doc. No. 682, 59th Cong., 1st sess., with map.) The mean range of tide is 3 feet. The length of the improved section is about 3,500 feet, and its lower end is at the 9-foot contour in Nanticoke River.

Condition at the end of fiscal year.—The improvement has been completed and maintained in fair condition by dredging under existing project. The controlling depth at mean low water is 7½ feet. The total expenditures on existing project were \$6,138.63 for new work and \$17,540.31 for maintenance, making a total of \$23,678.94. The project was completed in the fiscal year 1911.

Effect of improvement.—The improvement has made no appreciable difference in freight rates, but has afforded access for vessels

requiring project depth. It is also used as a harbor of refuge by a large number of oyster and fishing vessels in rough weather.

Proposed operations.—Available funds will be expended in removing a portion of shoaling found by a recent examination to have formed within the project limits, and amounting to 29,000 cubic yards of material. Available funds will be exhausted by June 30, 1917. It is proposed to apply the funds asked for in the removal of the remainder of existing shoaling and other obstructions, which experience since 1910 shows has amounted to about 15,000 cubic yards per year.

Commercial statistics.—The general character of the commerce for the calendar year 1915 consisted of agricultural products canned goods, general merchandise, oysters, etc.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	3,692	\$133,466
1914.....	3,987	134,188
1915.....	6,334	194,440

Amount expended on all projects from June 13, 1902, to June 30,

1916:

New work.....	\$16,296.63
Maintenance.....	17,540.31
Total	33,836.94

Balance available for fiscal year ending June 30, 1917..... 3,000.00

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 5,800.00

WICOMICO RIVER, MD.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1509, Sixty-third Congress, third session:

The Wicomico River rises in Wicomico County, Md., and flows in a general southwesterly direction a distance of about 33 miles, emptying into Monie Bay, an arm of Tangier Sound. The existing project provides for a channel 9 feet deep and of practicable width from the upper point of natural 9-foot depth to the Salisbury milldam in the North Prong and a turning basin 360 feet by 650 feet. Some shoals have developed in the lower river, and the improvement now desired is in the nature of a restoration of the channel, which has deteriorated, and an extension of the project into the South Prong, which has been dredged at private expense, and to deep water in the bay near the mouth of the river. The district officer submits estimates of cost of channels 9 and 10 feet deep at mean low water, amounting to \$17,100 and \$52,200, respectively, the channels to extend from the mouth of the river in Monie Bay to the bulkheads at the upper ends of the basins in the North and South Prongs at Salisbury. Considering the small proportion of craft benefited by the greater depth, and the difference of cost involved, he believes that the present project depth of 9 feet is sufficient for the present. The channel width proposed is 100 feet at bottom in straight reaches, suitably increased at bends. To this extent he believes the locality is worthy of further improvement by the United States, on condition that suitable dumping grounds are provided by local interests. The division engineer concurs in this opinion.

I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of Wicomico River, Md., is deemed advisable under a revised project providing for a channel 9 feet deep at mean low water, 100 feet wide at bottom, with suitably increased width at bends,

extending from deep water in Monie Bay to the head of navigation in the North and South Prongs at Salisbury, at an estimated cost of \$17,100 for construction and \$2,400 annually for maintenance, provided local interests will furnish free of cost to the United States suitable places for the deposit of dredged material, so protected as to prevent the return of the material to the navigable waters.

LOWER THOROUGHFARE AT OR NEAR WENONA, DEAL ISLAND, MD.

Location and description.—This is a tidal waterway, about $1\frac{1}{2}$ miles long and from one-eighth to one-half mile wide, between Deal Island and Little Deal Island, Md., extending from Tangier Sound. The trend of the current follows the ebb and flow of the tide. It is about 20 miles north of Crisfield Harbor, Md.

Existing project.—This was adopted by the river and harbor act of June 25, 1910, and provides for dredging a channel 6 feet deep and 80 feet wide at mean low water from Tangier Sound to the wharves at Wenona, Deal Island, with widening at the angles and ends, so as to furnish anchorage basins, at an estimated cost of \$5,300; estimated annual maintenance, \$200. (H. Doc. No. 76, 60th Cong., 1st sess., no map.) The estimated cost of the project was later increased to \$7,200. The mean range of tide is 2.2 feet. The length of the section included in the project is about one-half mile.

Condition at the end of fiscal year.—The improvement was completed in the fiscal year 1913 and has been maintained in fairly good condition by dredging under the existing project. The controlling depth at mean low water is $5\frac{1}{2}$ feet. Total expenditures on existing project were \$7,200 for new work and \$100 for maintenance, making a total of \$7,300.

Effect of improvement.—The improvement has had no effect on freight rates, but the small boats which could use the channel before improvement only at high water now use it at all stages of the tide. Sailing vessels from Tangier Sound frequently seek safe harbor here in severe storms.

Proposed operations.—It is proposed to expend funds asked for in removing shoals which were found by a recent examination to have formed within the project limits, requiring the removal of 15,000 cubic yards of material.

Commercial statistics.—The general character of the commerce for the calendar year 1915 consisted of crabs, cordwood, canned goods, general merchandise, oysters, etc.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	15,208	\$270,957
1914.....	12,584	217,030
1915.....	13,580	218,430

Amount expended on all projects from Mar. 3, 1871, to June 30, 1916:

New work.....	\$12,200.00
Maintenance	100.00
Total	<u>12,300.00</u>

Amount that can be profitably expended in fiscal year ending June

30, 1918, for maintenance of improvement.....	3,000.00
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CORSICA RIVER, MD.

Location and description.—This stream (formerly called Corsica Creek) is a tributary to Chester River. It rises in Queen Anne County, Md., is about 10 miles long, and, flowing in a generally westerly direction, empties into Chester River about 8 miles above Queens-town, Md. The stream is nearly all tidal.

Existing project.—This was adopted by the river and harbor act of July 25, 1912, and provides for dredging a channel 8 feet deep and 100 feet wide at mean low water from the 8-foot contour in Chester River to the wharf at Centerville, with a turning basin 200 by 300 feet at the upper end, at an estimated cost of \$5,368; cost of maintenance, \$400 per annum. (H. Doc. No. 537, 61st Cong., 2d sess., with map.) The estimated cost of the project was later increased to \$10,168. The mean range of tide is about 2 feet. The length of the section included in the project is about 5 miles, and its lower end extends into Chester River.

Condition at the end of fiscal year.—The improvement has been completed and maintained in good condition by dredging under existing project. The controlling depth at mean low water is 8 feet. The total expenditures on existing project were \$9,070.85 for new work and \$1,097.15 for maintenance, making a total of \$10,168. The project was completed in the fiscal year 1916 for \$1,097.15 less than the estimate.

Effect of improvement.—It is stated that the effect of this project has been to reduce rail rates.

Proposed operations.—It is proposed to expend funds asked for in removing shoals which were found by recent examination to have formed within the project limit, requiring the removal of 14,000 cubic yards of material.

Commercial statistics.—The general character of the commerce for the calendar year 1915 consisted of bricks, coal, canned goods, fertilizers, and general merchandise.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	50,746	\$786,900
1914.....	43,999	734,200
1915.....	44,300	642,600

Amount expended on all projects from August 2, 1882, to June 30, 1916:

New work.....	\$39,070.85
Maintenance.....	1,097.15
Total.....	<u>40,168.00</u>

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 2,800.00

BIG ANNEMESSEX RIVER, MD.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1328, Sixty-third Congress, second session:

Big Annemessex River is a tributary of Tangier Sound, Chesapeake Bay, which it enters a few miles north of the town of Crisfield, Md. The navigable portion of the river is really a bay or inlet about a mile and a half wide at

its mouth and extending to the northeast, with a navigable depth of 7 feet or greater for a distance of about 6 miles, at which point it dwindles to an insignificant depth. Fords Wharf, which is located between Clear Creek Point and Muddy Creek Point, is practically the only landing on the north side of the stream and serves as an outlet for the commerce of several settlements with an aggregate population of between 3,000 and 4,000, engaged principally in fishing, oystering, and crabbing, and to a lesser extent in trucking. The improvement desired by interested parties is stated by the district officer to be a channel 8 feet deep at mean low water through the middle ground or shoal area lying between the main channel of the Big Annemessex River and the wharf. He submits a plan providing for a channel of the desired depth of 8 feet and a width of 100 feet, with a turning basin at the wharf, at an estimated cost of \$5,600, and recommends that improvement to this extent be undertaken by the United States, provided that local interests shall first repair the wharf, restore the road thereto, and construct a suitable terminal building within one year from the date of the appropriation by the United States for the improvement. The division engineer concurs in the views and recommendations of the district officer.

I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Big Annemessex River, Md., is deemed advisable to the extent of providing a channel 8 feet deep at mean low water and 100 feet wide from the main channel of the river to Fords Wharf, with a turning basin at the wharf, as shown on accompanying map, at an estimated cost of \$5,600, provided that local interests first restore the wharf and the road leading thereto and construct a suitable terminal building as proposed by the district officer.

POTOMAC RIVER AT WASHINGTON, D. C.

Location and description.—The Potomac River is formed by the junction of the north and south branches, about 21 miles below Cumberland, Md., and flows in a generally southeasterly direction about 286 miles to Chesapeake Bay, which it enters about 80 miles from the Atlantic Ocean. Below Washington the river partakes of the character of a tidal estuary. The drainage area of the river is 20,000 square miles.

Existing project.—The existing project, estimated originally to cost \$2,500,000, was adopted by the river and harbor act of August 2, 1882, and is contained in Senate Executive Document No. 126, Forty-seventh Congress, first session, with map (also printed, without maps, in Annual Report for 1882, p. 980). The area included in the project extends from the Aqueduct Bridge downstream 5 miles to Giesboro Point, which is 108 miles from the mouth of the river. The project provides for dredging the Virginia Channel 20 feet deep and of sufficient width (now about 500 feet) to afford a low-water cross-sectional area of 25,000 square feet; for dredging the Washington Channel at least 20 feet deep; for the reclamation of the flats to 3 feet above the freshet elevation of 1877 by depositing the dredged material thereon; for the construction of a tidal reservoir to periodically flush the Washington Channel, and for the construction of a training dike in the Virginia Channel. The plane of reference is mean low water, and the mean tidal range is 3 feet.

Condition at end of fiscal year.—The expenditures to June 30, 1916, were \$2,456,067.14 for new work and maintenance prior to March 3, 1899, and \$687,384.48 for maintenance since March 3, 1899, a total of \$3,143,451.62. The project was completed in 1913 for less than the estimate, the saving being \$43,932.86. From these expenditures there has resulted: Channels of project depth 4 miles long and

about 500 feet wide in the Virginia Channel; $2\frac{3}{4}$ miles long and 400 feet wide in the Washington Channel, and an additional width along the west side of the Washington Channel of 350 feet, 18 to 20 feet deep; a tidal reservoir (111 acres in area) with inlet and outlet gates; the complete reclamation of Potomac Park (628 acres); the construction of 36,975 linear feet of sea wall; the building of 7,207 linear feet of training dike; and the excavation of 19,673,235 cubic yards of material. All completed works are in good condition. The controlling depth in the Virginia Channel is 18 feet, and in the Washington Channel 22 feet. The controlling depth in the Potomac Channel below Washington is 23 feet at mean low water.

Local cooperation.—The District of Columbia has built a municipal fish wharf on the Washington Channel at a cost of about \$50,000.

Effect of improvement.—Larger and deeper draft vessels are now engaged in trade. It is reported that freight rates have been materially reduced. Through rates to Norfolk by water are less than by rail. The reclamation of the Potomac flats has resulted in the substitution for a malaria-breeding tidal flat of one of the most beautiful parks in the country.

Proposed operations.—It is proposed to expend the funds provided in the river and harbor act approved July 27, 1916, together with the available balance July 1, 1916, of \$12,026.62, as follows:

Dredging channel around deposit basin on Virginia shore	9,000.00
Operation and maintenance of tidal gates	2,500.00
Dredging where shoals may occur	20,000.00
Maintenance of U. S. tug <i>Castle</i>	1,500.00
Care of property and plant	1,200.00
Repairs to Virginia training dike	1,000.00
Masonry sea wall at Easby Point	2,000.00
Engineering, contingencies, etc	6,826.62
Total	44,026.62

The work will be carried on continuously during the year, and the funds will probably be exhausted by June 30, 1917.

It is proposed to expend the funds requested for the fiscal year 1918 as follows:

Operation and maintenance of tidal gates	\$2,500
Dredging where shoals may occur	17,000
Maintenance of U. S. tug <i>Castle</i>	1,500
Care of property and plant	1,200
Repairing dikes	1,000
Engineering, contingencies, etc	6,800
Total	30,000

Previous reports have carried a statement that the estimated cost of maintenance was about \$15,000, but experience has shown this sum to be insufficient. The removal of the annual deposit of about 100,000 cubic yards of mud in the channels, and the care of existing works and plant, requires a greater expenditure than had been contemplated. The material removed will be used for the progressive reclamation of public land on the Virginia side of the river.

Commercial statistics.—Commerce for the calendar year 1915 is reported as 741,170 short tons, valued at \$10,138,31, the principal items in order of tonnage, being sand and gravel, coal, stone, general merchandise, cordwood, gas, oil, lumber, brick, and oysters and

clams. The entire commerce passed over the improved sections. About 50 per cent required the increased depth and width afforded by the improvement. During the year the Peoples Line inaugurated a general freight and passenger business with one steamer.

Comparative statement.

Calendar years.	Tons.	Value.
1913.....	823,038	\$12,141,079
1914.....	812,284	11,321,910
1915.....	741,170	10,138,231

Amount expended on all projects from Mar. 2, 1833, to June 30.	
1916:	
New work.....	\$2,795,542.35
Maintenance.....	687,384.48
Total	3,482,926.83
Balance available for fiscal year ending June 30, 1917.....	44,026.62
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	30,000.00

NORFOLK HARBOR, VA., AND VICINITY—NEW PROJECT.

Abstract from the report of the Chief of Engineers, printed in House Document 605, Sixty-third Congress, second session:

The existing projects for improvement of these localities were adopted by the river and harbor act approved June 25, 1910. The district officer considers the several localities under their project designations, as follows:

THIMBLE SHOAL CHANNEL.

This channel, which connects the deep water of Hampton Roads with the ocean, will have a depth of 35 feet at mean low water, and will be nowhere less than 500 feet in width when completed. The district officer reports that it would appear, for the present at least, that the projected width of this channel is sufficient.

CHANNEL TO NEWPORT NEWS.

This channel was completed over a year ago to its project depth of 35 feet and width of 400 feet. On account of its distance from the shore, the impracticability of establishing ranges, and the difficulty of keeping the sides of the channel accurately marked by reason of the effect of cross currents on the buoys, he is of opinion that the channel should be widened to 600 feet, at an estimated cost of \$270,000, the cost of maintenance being the same as at present, \$15,000 per annum.

NORFOLK CHANNEL.

The Norfolk Channel extends from deep water in Hampton Roads up the main portion of the Elizabeth River to the junction of its branches and thence up the Southern Branch to above the Norfolk Navy Yard. The present channel, completed about a year ago, has a depth of 35 feet at mean low water and a width of 400 feet. In addition to carrying an annual commerce estimated at about 22,000,000 tons, this channel is traversed by naval vessels, including the largest colliers and battleships. The district officer is of opinion that the Norfolk Channel requires widening, and he recommends that its width be increased to 600 feet as far up as the mouth of the Southern Branch, thence 450 feet wide up the Southern Branch as far as the lower end of the navy yard, 600 feet wide along part of the navy-yard front, and 800 feet wide along the upper end of the navy-yard front, as far as the Belt Line Bridge. The esti-

uated cost of this work is \$840,000, of which \$130,000 is on hand, leaving \$710,000 additional to be provided; the estimated cost of maintenance is \$15,000 per annum.

ANCHORAGES.

The district officer states that the anchorages along the Norfolk Channel are restricted in area and are frequently congested. He is of opinion that additional anchorage space is required, and that for economy anchorages of different depths should be provided for different classes of vessels. For large vessels he proposes an anchorage of 64 acres 35 feet deep northwestward from Lamberts Point, at an estimated cost of \$99,000. Southward of and adjoining the above is an anchorage of 62 acres, having a low-water depth of 24 feet or more. For small barges and canal boats bound to or from the waterway southward for Norfolk, he proposes an anchorage of 45 acres 12 feet deep westward of the main channel and between the Western Branch and Pinners Point, at an estimated cost of \$35,000. He believes that it is advisable for the United States to undertake the construction of these anchorages on condition that the locality or the interests affected will provide and maintain such mooring buoys or other facilities for anchoring vessels as the Secretary of War may consider just and proper.

I concur in general with the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement of Norfolk Harbor and vicinity is deemed advisable to the extent proposed by the district officer, as follows:

Widening Newport News Channel to 600 feet-----	\$270, 000
Widening Norfolk Channel-----	840, 000
For 35-foot anchorage opposite Lamberts Point-----	99, 000
For 12-foot anchorage near Pinners Point-----	35, 000
Total-----	1, 244, 000

While the above estimate covers the widening of the lower part of the Southern Branch to 450 feet only, it is believed that the project width should be 600 feet, as recommended by the board, to meet possible future necessities.

MATTAPONI AND PAMUNKEY RIVERS, VA.

MATTAPONI RIVER, VA.

Location and description.—The Mattaponi River rises in Virginia and flows in a southeasterly direction for about 120 miles to its junction with the Pamunkey River, forming the York River, at Westpoint, Va. The drainage area is 800 square miles. The discharge varies from 50 to 20,000 second-feet. Freshets occur in the spring.

Existing project.—The project for the improvement of this stream, estimated to cost \$34,059, was adopted by the river and harbor act of June 14, 1880, and is contained in the Annual Report of the Chief of Engineers for 1875, volume 2, page 166, without maps. The section covered by the project extended from Line Tree Bar, 31 miles by river above the mouth, to Munday Bridge. This project was extended to cover the removal of snags as far as Guinea Bridge, 71 miles above Line Tree Bar, by the act of July 13, 1892. The project provides for the removal of snags, wrecks, and leaning trees below Guinea Bridge and the improvement of the bars below Aylett, so as to give a depth of 5½ feet at mean low water and a channel width of 40 feet. The estimated cost of the extended project was \$72,100. The plane of reference is mean low water and the mean range of tide is 3.9 feet at Walkerton and 2.9 feet at Westpoint.

Condition at end of fiscal year.—The project was completed in 1914 for less than the estimate, the saving being \$17,200.28. The expenditures to June 30, 1916, were \$54,899.72 for new work and for

maintenance prior to March 3, 1899, and \$50,493.86 for maintenance since March 3, 1899, a total of \$105,393.58. The channel on the stretch from Aylett to the lower end of Line Tree Bar has been dredged through 13 bars, aggregating 4.4 miles in length, the quantity dredged being 297,293 cubic yards. Snags have been removed in other parts of the river. The maximum draft that can be carried over the shoalest part of the channel below Aylett is $5\frac{1}{2}$ feet at mean low water.

Effect of improvement.—Steamers can now make their calls at river landings without reference to the tide. Shipments have been facilitated, and it is understood that freight rates have been somewhat reduced.

Proposed operations.—It is proposed to devote \$4,000 of the \$15,000 for the four improvements in the river and harbor act approved July 27, 1916, together with the available balance, July 1, 1916, \$3,978.23, from former appropriation, to the maintenance of the existing improvement, as follows:

Dredging where shoals may occur-----	\$4,000.00
Maintenance of U. S. tug <i>Castle</i> -----	500.00
Care of property and repairs to floating plant-----	500.00
Snagging river-----	1,000.00
Engineering, contingencies, etc-----	1,978.23
Total-----	7,978.23

The work will be carried on during the fiscal year as plant can be spared from more important work, and the funds will be exhausted during the fiscal year.

It is proposed to expend the \$2,000 requested for the fiscal year 1918 in necessary work of maintenance.

Commercial statistics.—Commerce for the calendar year 1915 is reported as 52,737 short tons, valued at \$811,030, the principal items in the order of tonnage being lumber, pulp wood, railroad ties, farm produce, general merchandise, fertilizer, lime, and canned goods. About 52 per cent of the total commerce passed over the improved sections, 8 per cent of which was affected by the increased depth and width afforded by the improvement.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	73,277	\$1,103,030
1914.....	60,190	685,693
1915.....	52,737	811,030

Amount expended on all projects from June 14, 1880, to June 30, 1916:

New work-----	\$54,899.72
Maintenance-----	50,493.86
Total-----	105,393.58

Balance available for fiscal year ending June 30, 1917-----	7,978.23
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	2,000.00

PAMUNKEY RIVER, VA.

Location and description.—The Pamunkey River rises in Virginia and flows in a southeasterly direction for 130 miles to its junction with the Mattaponi River, forming the York River at West Point, Va. Its drainage area is 1,406 square miles and its fluvial discharge varies from 150 to 40,000 second-feet. Freshets rise 22 feet at Han-overtown, 52 miles above the mouth. The lower 47 miles, which include the entire section under improvement, are tidal.

Existing project.—The project, estimated in its original form to cost \$17,508, was adopted by the river and harbor act of June 14, 1880, and is contained in the Annual Report for 1875, Part II, page 162, without maps. The project was modified in 1885 and 1908, partly by increasing the depth and width of channel below Bassett Ferry and partly by omitting the portion of the river above Bassett Ferry. The section requiring work under the existing project extends from Buckland Bar upstream to Bassett Ferry, a distance of 10 miles. Buckland Bar is 40 miles above the mouth of the river. The project now provides for securing a channel 7 feet deep and 100 feet wide between Bassett Ferry and the mouth of the river. The estimate of cost of the revised project was \$55,000 for new work and \$4,000 every four years for maintenance. The plane of reference is mean low water, and the mean range of tide is about 3.5 feet.

Condition at end of fiscal year.—The project was completed in 1913 for less than the estimate, the saving being \$15,333.77. The expenditures to June 30, 1916, were \$39,666.23 for new work and maintenance prior to March 3, 1899, and \$24,154.14 for maintenance since March 3, 1899, a total of \$63,820.37. Sheet-pile longitudinal dikes aggregating 1,478 linear feet and permeable spur dikes aggregating 2,332 linear feet have been built. The amount of material excavated was 91,884 cubic yards. Innumerable logs, snags, etc., and eight wrecks have been removed. All works are now in good condition.

Effect of improvement.—Vessels drawing 7 feet can now reach Bassett Ferry. Shipments have been facilitated. It is stated that freight rates have been reduced.

Proposed operations.—It is proposed to devote \$2,000 of the \$15,000 for these four improvements carried in the river and harbor act approved July 27, 1916, to the maintenance of the existing improvement, as follows:

Maintenance of U. S. tug <i>Castle</i>	\$300
Care of property and plant.....	300
Snagging river.....	1,000
Engineering, contingencies, etc.....	400
Total.....	2,000

The work will be carried on during the fiscal year as plant is available, and the funds will be exhausted during the fiscal year ending June 30, 1917.

It is proposed to expend the funds requested for the fiscal year 1918 as follows:

Dredging where shoals may occur.....	\$1,100
Maintenance of U. S. tug <i>Castle</i>	300
Care of property and plant.....	300
Snagging.....	1,000
Engineering, contingencies, etc.....	300
Total.....	3,000

The above funds will be used for the maintenance of the existing project, and will probably be exhausted by June 30, 1918. This amount is in excess of the project estimate for maintenance and the past average expenditures, but it has been found in practice that \$1,000 per annum is required for snagging alone. In order to accomplish the necessary dredging this increased estimate is accordingly submitted.

Commercial statistics.—Commerce for the calendar year 1915 is reported as 47,004 short tons, valued at \$212,343, the principal items, in order of tonnage, being lumber, pulp wood, railroad ties, lime, and fertilizer. About 60 per cent of this commerce passed over the improved sections, all of which was affected by the increased depth and width afforded by the improvement.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	36,990	\$236,257
1914.....	35,703	194,953
1915.....	47,004	212,343

Amount expended on all projects from June 14, 1880, to June 30, 1916:

New work.....	\$39,666.23
Maintenance	24,154.14
Total.....	63,820.37
Balance available for fiscal year ending June 30, 1917.....	2,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	3,000.00

RAPPAHANNOCK RIVER, VA.

Location and description.—The Rappahannock River rises in Virginia in the Blue Ridge Mountains and flows in a southeasterly direction for about 212 miles to Chesapeake Bay, which it enters about 40 miles above Fort Monroe. In its lower 70 miles the river is generally a wide and deep body of water, having the characteristics of a tidal estuary rather than of a fluvial stream.

Existing project.—The existing project was adopted October 25, 1905, under authority given by the river and harbor act of March 3, 1905, and is contained in the Annual Report of the Chief of Engineers for 1906, pages 1110–1113, with map. It provides for securing a channel 12 feet deep and 100 feet wide between Fredericksburg and Port Royal and 12 feet deep and 200 feet wide between Port Royal and the mouth of the river. This result is to be obtained by dredging and the construction of dikes, the latter being also designed to retain the excavated material deposited behind them. The estimated cost of this project was \$171,000, exclusive of the amount previously spent, with an annual maintenance charge of \$10,000. The mean range of tide is 2.8 feet at Fredericksburg and 1.6 feet at Tappahannock. The plane of reference is mean low water.

Condition at end of fiscal year.—The project was completed in 1910. The expenditures to June 30, 1916, were \$218,597.20 for new work and \$68,314.35 for maintenance, a total of \$286,911.55. A channel of project width throughout the entire improved section has been obtained by

the excavation of 808,516 cubic yards of material. In all, 20,401 linear feet of timber dikes have been built, and 1,906 linear feet of riprap dike have been constructed by the placement of 3,625 cubic yards of riprap stone. All works are now in condition to perform their functions, but are in need of extensive repairs to insure their permanence, having suffered from lack of funds for the past few years.

Effect of improvement.—The coastwise trade has been afforded access to the upper river.

Proposed operations.—It is proposed to expend the funds provided in the river and harbor act approved July 27, 1916, together with the available balance July 1, 1916, of \$7,527.34, as follows:

Dredging where shoals occur	\$24,000.00
Maintenance of U. S. tug <i>Castle</i>	2,000.00
Care of property and plant	1,500.00
Repairing dikes and protecting sand fills	4,000.00
Engineering, contingencies, etc	6,027.34
Total	37,527.34

This work will be done in the spring of 1917, and the funds will probably be exhausted by June 30, 1917.

It is proposed to expend the funds requested for the fiscal year 1918 as follows:

Dredging where shoals may occur	\$5,000
Maintenance of U. S. tug <i>Castle</i>	1,000
Care of property and plant	700
Repairing dikes	2,500
Engineering, contingencies, etc	800
Total	10,000

The usual project estimate for maintenance is submitted, notwithstanding the increase for 1917, because this increased appropriation will be largely utilized in correcting conditions due to insufficient appropriations in the past.

Commercial statistics.—Commerce for the calendar year 1915 is reported as 233,161 short tons, valued at \$6,458,344, the principal items, in order of tonnage, being pulp wood, railroad ties, general merchandise, farm produce, lumber, oysters, cordwood, coal and fertilizer. About 60 per cent of the entire commerce passed over the improved sections, all of which required the increased depths and width afforded by the improvement.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	251,070	\$6,657,369
1914.....	206,939	6,327,305
1915.....	233,161	6,458,344

Amount expended on all projects from Mar. 3, 1871, to June 30, 1916:

New work	\$415,743.03
Maintenance	181,814.35

Total 597,557.38

Balance available for fiscal year ending June 30, 1917 37,527.34

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement 10,000.00

PAGAN RIVER, VA.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document No. 591, Sixty-fourth Congress, first session :

Pagan River is a tributary of the James River, which enters from the right bank about 7 miles above Hampton Roads. The head of navigation for boats is at Smithfield, Va., 5 miles above the mouth, but rafting may be carried on for 3 miles farther upstream. By the expenditure of \$10,671.01, authorized by the act of March 3, 1905, a channel 40 feet wide and 10 feet deep at mean low water was made available. The present project, which has been completed, was adopted by the act of June 25, 1910, and provides for widening the channel at Smithfield and at a bend one-half mile below Smithfield, and for dredging off the points of abrupt bends farther downstream. The commerce of this stream for 1914 is reported as amounting to 38,080 tons, valued at \$11,424,000. This commerce is largely carried by the regular steamers plying on the James River, for which the present depth appears sufficient, but the width is inadequate. The district officer presents a project providing for a channel 80 feet wide and 10 feet deep at mean low water, at an estimated cost of \$25,000, and expresses the opinion that it is advisable to undertake the further improvement of the river to this extent. The division engineer concurs in this opinion, but believes that the estimate should be increased to \$30,000.

I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of Pagan River, Va., is deemed advisable to the extent of providing a channel 80 feet wide and 10 feet deep at mean low water up to Smithfield, as shown on accompanying maps, at an estimated cost of \$25,000 for first construction and \$2,000 per annum for maintenance.

NANSEMOND RIVER, VA.

Location and description.—This stream rises in Nansemond County, Va., and flows 25 miles in a northerly direction into Hampton Roads. The portion under improvement lies between Suffolk, Va., and the mouth, a distance of 18 miles. Its drainage area is 262 square miles, fresh-water discharge small, and floods negligible. It is a tidal stream. The width between banks varies from 150 to 9,500 feet.

Existing project.—This was adopted by the river and harbor act of August 11, 1888. (Annual Report for 1887, p. 1001.) It provides for procuring a channel by regulation works and dredging, 100 feet wide and 12 feet deep at mean low water from the head of navigation to the mouth of the Western Branch, a distance of 7.37 miles, and the excavation of a turning basin at Suffolk Bridge, 200 feet square; pile spurs and training walls at the mouth of the Western Branch; also for securing by regulation and dredging a channel of the same depth and from 200 to 400 feet wide, 8.3 miles long, from the Western Branch to Town Point, 2.3 miles above the mouth, all at an estimated cost of \$152,500. No reference is made in the project to maintenance. The mean tidal variation is 3.78 feet at Suffolk Bridge and 3.01 feet at Newmans Point. (For map, see H. Doc. No. 1246, 62d Cong., 3d sess.)

Condition at the end of the fiscal year.—Operations in 1910 and prior years resulted in giving a channel 12 feet deep at mean low water and 80 feet wide from Suffolk to the mouth, a distance of 18 miles, and a turning basin at Suffolk. Some shoaling and a further decay of training walls is noted. The controlling depth on the improvement is 11 feet at mean low water. The total expenditure under the existing adopted project, exclusive of outstanding lia-

bilities and contract obligations, has been \$60,412.17, of which \$42,677.11 was for original work and \$17,735.06 for maintenance.

Effect of improvement.—Navigation has been rendered easier, better, and safer. It is believed that the existence of the navigable channel gives Suffolk more favorable rail rates.

Proposed operations.—With the funds on hand the necessary examinations will be made, and snags and shoals will be removed from the river as required. With the additional funds asked for it is proposed to repair the spurs and training walls at the mouth of the Western Branch. The amount required is \$6,000. It is not proposed to maintain the channel to a greater depth than 11 feet or greater width than 75 feet, as these dimensions are ample for present and prospective commerce.

Recommended modifications of project.—None.

Commercial statistics.—The commerce of this river consists of brick, clay, coal, lumber, and general merchandise.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	88,821	\$2,369.86
1914.....	81,738	554.86
1915.....	50,351	570.73

Financial summary.

Amount expended on all projects from Mar. 3, 1873, to June 30, 1916:

New work.....	\$72,677.11
Maintenance.....	24,735.06

Total.....	97,412.17
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July 1, 1916, balance unexpended.....	2,587.83
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	6,000.00
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JAMES RIVER, VA.

Location and description.—This river is formed by the junction of the Cowpasture and Jackson Rivers, in Botetourt County, Va., and flows easterly 320 miles into Hampton Roads. The portion under improvement is tidal and extends from Richmond to its mouth, a distance of 103.8 miles.

Existing project.—This project was adopted by the river and harbor act of July 5, 1884 (S. Doc. No. 147, 47th Cong., 1st sess.), and it provides for the formation by regularization and excavation of a channel from the mouth to Richmond 22 feet deep at mean low water, and a width of 400 feet from the mouth to City Point, a distance of 71.8 miles, thence to Drewry Bluff, a distance of 25 miles, a width of 300 feet, and thence to Richmond, a distance of 7 miles, a width of 200 feet, at a total estimated cost of \$4,500,000. The river and harbor act of June 13, 1902 (H. Doc. No. 234, 56th Cong., 1st sess., with map), extended the improvement 3,300 feet upstream to the head of navigation at the docks, with a width of 200 feet and a depth of 22 feet at mean low water, at an additional cost of \$724,943.15.

By the river and harbor act of March 3, 1905 (H. Doc. No. 234, 56th Cong., 1st sess.), the project was further extended to include the excavation of a turning basin at Richmond by increasing the width of the proposed channel to 400 feet for a length of 600 feet, the depth to be 22 feet at mean low water, at a cost not to exceed \$150,000. The proposed dimensions of channels where regulation works are used are 200 and 300 feet wide by 22 feet deep at mean low water. The works are sheet-piling spurs and training dikes revetted with stone.

The total length of river now included in the project is 103.8 miles, of which 20 miles immediately below Richmond is being improved both by regularization and dredging and the remainder by dredging alone at such points as require it. The total estimated cost for the entire project, including extensions, is \$5,374,943.15. No reference is made to maintenance in either the approved project or its extensions. The mean tidal range for different parts of the river is as follows: Mouth, $2\frac{1}{2}$ feet; Jamestown, 1.85 feet; City Point, 3 feet; Dutch Gap, $3\frac{1}{2}$ feet; Richmond, 4 feet.

Condition at the end of fiscal year.—The character of work done under the existing project and previous projects has consisted of dredging in the upper $6\frac{1}{4}$ miles of the portion of the river under improvement, in the upper 3 miles of which extensive rock excavation was done; dredging on 3 of the 6 shoals from $7\frac{1}{2}$ to 21 miles below Richmond, and on 7 shoals between City Point and the river's mouth. Regulation works have been constructed for maintaining the channel for $6\frac{1}{2}$ miles immediately below Richmond, and on the 6 shoals above referred to. The project was about 50 per cent completed June 30, 1916. The result of the work is a channel from Hampton Roads to the City Wharf at Richmond, a distance of 103.8 miles, having a minimum depth of 18 feet at mean low water. Drafts of 15 to 18 feet can be carried at low tide from Hampton Roads to Richmond throughout the year, depending on the elevations of the low tides with reference to the plane of mean low water. The work remaining to be done to complete the project would consist in deepening the channel from its present depth of 18 feet to 22 feet at mean low water, and widening parts of the channel between City Point and Richmond to the project widths of 200 and 300 feet.

A total of \$2,485,296.42 has been expended under the existing project to the end of the fiscal year, not including outstanding liabilities or contract obligations, of which \$2,385,005.46 was for new work, and \$100,290.96 for maintenance. The expenditure of maintenance is for the period subsequent to March 3, 1899, prior to which no account was kept of this item.

Local cooperation.—The city of Richmond has voluntarily expended \$1,044,476.65 in the improvement of the channel and construction of public terminals.

Effect of improvement.—The work has been beneficial in permitting the use of larger and deeper-draft vessels and in reducing the cost of water transportation of lumber, fertilizer material, coal, and other articles carried in sailing vessels and barges. In many cases the freight rates on commodities transported by steamers are the same as rail rates.

Proposed operations.—It is proposed, with the balance of funds available at the end of the fiscal year, amounting to \$1,735.33, to

proceed with preparations for future work, and with the appropriation made by the river and harbor act approved July 27, 1916, to perform the following work:

To enlarge channel to complete the turning basin at Richmond, Va., for its full length of 600 feet and width of 400 feet, with a depth of 18 feet at mean low water-----	\$80,000
To enlarge about 28,000 square feet of channel contiguous to the turning basin-----	49,000
To construct regulation works at and below Richmond, Va-----	9,000
Removing deposits from channel at Richmond, Va., by dredging-----	28,000
Supervision, inspection, launch service, and contingencies-----	24,000
Total-----	190,000

It is expected to complete preparations for and begin the above work in the fall of 1916, and to complete it and exhaust the appropriation in January, 1918. It is proposed to carry on the rock excavation and dredging at Richmond continuously and, after the first month, to proceed with the other branches of the work till completed. The monthly expenditures are estimated as follows: For the first month, \$9,000; the next five months, \$10,000; the next three months, \$17,000; the next four months, \$16,000; and the last two months, \$8,000.

The estimated amount that can be profitably expended in the remainder of the fiscal year ending June 30, 1918, is \$56,000. It is proposed to expend this amount for dredging and construction of regulation works at and below Richmond, Va., in accordance with the following estimate of funds:

Enlarging the part of channel contiguous to the turning basin between the head of navigation at the docks, Richmond, Va., and southern city limits-----	\$32,500
Constructing regulation works below Richmond-----	6,500
Maintenance of dredged channel at and below Richmond-----	10,000
Supervision, inspection, launch service, and contingencies-----	7,000
Total-----	56,000

It is proposed to proceed with all branches of the work simultaneously, and exhaust the appropriation about June 30, 1918.

Commercial statistics.—Of the river traffic during the year 1915 39 per cent consisted of forest products, carried in barges of 6 to 15 feet draft; 33 per cent consisted of general merchandise, carried principally in steam vessels drawing from 7 to 14 feet; 7 per cent oils and gasoline, in barges of 14 feet draft; and 7 per cent anthracite coal, in barges drawing about 11 feet.

Comparative statement.

Calendar years.	Short tons.	Value.
1913.....	592,165	\$33,523,461
1914.....	452,950	32,813,455
1915.....	526,468	51,899,841

The increases in tonnage and value of traffic for 1915 over those of 1914, amounting to about 74,000 tons and \$19,000,000, respectively, resulted from the improved business conditions in 1915. During the year a new steamboat line with two boats of 106 and 71 tons, gross,

was established between Richmond and City Point. Another steamer of about 217 tons, gross, was added to the Furman Line to ply between Richmond and City Point.

Amount expended on all projects from July 5, 1884, to June 30, 1916:

New work	\$3, 148, 005. 46
Maintenance	100, 290. 96
Total	3, 248, 296. 42
Balance available for fiscal year ending June 30, 1917.....	191, 735. 33
Amount (estimated) required to be appropriated for completion of existing project.....	2, 797, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918:	
For works of improvement	46, 000. 00
For maintenance of improvement.....	10, 000. 00
Total	56, 000. 00

APPOMATTOX RIVER, VA.

Location and description.—This river rises in Appomattox County, Va., and flows northeasterly 137 miles into the James River. The portion under improvement is tidal and extends from Petersburg, Va., to its mouth, a distance of 11 miles.

Condition at the end of the fiscal year.—The project for the general improvement of the river was completed in 1912, giving a channel from Petersburg to the mouth, a distance of 11 miles, with an original width of 80 feet and a depth at mean high water of 11 feet. The diversion plan was 94 per cent completed, when the dam was broken by a freshet in March, 1912, since which date no work has been done. The controlling depth in the navigable channel is 7.5 feet at mean low water. The total expenditure under the existing adopted project for the general improvement to the end of the fiscal year, exclusive of outstanding liabilities and contract obligations, was \$27,666.64, of which the sum of \$15,215.95 was for original work and \$12,450.69 for maintenance. The total expenditure for the diversion project to the end of the fiscal year was \$243,941.21, of which \$243,931.21 was for original work and \$10 for maintenance. There remains to complete the existing project for the diversion at Petersburg, the construction of an earth dam and embankment above the navigable channel and a conduit, extending from the diversion channel to the navigable channel at Petersburg, Va., for flushing the latter channel.

Local cooperation.—Between 1866 and 1912 the city of Petersburg has voluntarily expended \$1,582,837 on the improvement of the Appomattox River. The work consisted in dredging and dike construction for 7½ miles below Petersburg.

Effect of improvement.—The improvement has made navigation safer and easier, and has resulted in more favorable freight rates to and from Petersburg.

Proposed operations.—It is proposed with the balance of funds available for the general improvement to do such dredging of freshet deposits in the navigable channel as may be necessary and possible. It is believed that the funds will be exhausted at the close of the fiscal year 1917. This time, however, can not be definitely stated, as

it will be governed by the extent of the deposits to be removed. The estimated additional amount required for maintenance of the navigable channel by dredging during the fiscal year ending June 30, 1918, is \$5,000. No work is recommended to be done on the diversion scheme either for the fiscal year of 1917 or 1918 as it is not known when the city of Petersburg, Va., and the Norfolk & Western Railroad Co. will do the work they agreed on in October, 1912, which would make further work advisable by the Government.

Commercial statistics.—The principal articles of water-borne commerce in the calendar year 1915 were peanuts, fertilizer, fertilizer material, and general merchandise.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	33,252	\$1,036,840
1914.....	40,172	1,364,186
1915.....	46,600	3,318,908

The increase in tonnage and value of freight for 1915 over 1914 resulted from the improved business conditions and the establishment of the new town of Hopewell at the mouth of the river. An additional boat of 217 tons, gross, was placed on the river and plied between Petersburg, City Point, and Richmond.

CONSOLIDATED.

Amount expended on all projects from 1852 to June 30, 1916:

New work	\$753,567.16
Maintenance	7,056.73

Total	824,623.89
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July 1, 1916, balance available	11,041.08
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Amount (estimated) required to be appropriated for completion of existing project	16,000.00
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	5,000.00
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APPOMATTOX RIVER, VA.—SUPPLEMENTAL ESTIMATE.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
Norfolk, Va., December 19, 1916.

From: The District Engineer Officer, Norfolk, Va.

To: The Chief of Engineers, United States Army, Washington, D. C.

(Through the Division Engineer, Eastern Division.)

Subject: Improvement of Appomattox River, Va.

1. Under date of March 2, 1916, I submitted to the Chief of Engineers, United States Army, through the division engineer, southeast division, a report, in which I expressed my opinion that the city of Petersburg, Va., and the Norfolk & Western Railway Co. would have shortly substantially complied with the terms of an agreement entered into October 10, 1912, under which the United States was to complete the diversion project for the Appomattox River, Va., when certain work had been accomplished by the city of Petersburg and the Norfolk & Western Railway Co.

2. In this report a new estimate of the amount necessary to complete the work was given. At that time it was thought that the diversion work could be completed for a total of \$32,000, and that the channel work carried on under the

head "General improvement" could be restored to its project dimensions for \$16,000.

3. I am now in receipt of a communication from the secretary of the Chamber of Commerce of Petersburg, Va., with which he forwards a certified copy of the action of the common council and the board of aldermen of the city of Petersburg, making the necessary appropriations to complete the work required to be done by the city of Petersburg, and a letter from the chief engineer of the Norfolk & Western Railway Co., in which he states that his company will proceed with the raising of its track as soon as the work contemplated by the city of Petersburg is completed. (Copies of these last two communications are inclosed herewith.)

4. The work to be done by the Norfolk & Western Railway Co. and the work to be done by the Federal Government should be carried on simultaneously, and it is probable that the railroad work will be commenced early in the spring of 1917. The Government should, therefore, be in position to begin carrying out its part of the agreement at the same time, and I am of the opinion that an item should be incorporated in the pending river and harbor bill appropriating the necessary funds for the work in question. Since the estimate of March 2, 1916, was submitted there has been a marked advance in the cost of labor and materials, especially coal, and the estimate then given should be increased by 25 per cent in order to cover present conditions. A total of \$60,000 will therefore be needed, of which \$40,000 is required for completing the diversion project and \$20,000 for restoring the navigable channel to its project dimensions. There is at present on hand an unexpended balance of about \$10,000, all of which, in the opinion of this office, may be used in the maintenance of the general improvement. An additional appropriation of \$50,000 is therefore necessary, of which \$10,000 would be needed for general improvement and \$40,000 for completion of the diversion project. After the completion of the diversion project and the restoration of the navigable channel to its project dimensions, the cost of maintenance will be \$3,000 per year, of which \$1,000 will be applied to the diversion channel and \$2,000 to general improvement.

5. A copy of a letter from the traffic manager of the Furman Line, operating steamers between Petersburg and Richmond and intermediate landings via City Point, Va., which shows the need of restoring the navigable channel to its project dimensions, is also inclosed herewith.

6. I therefore recommend that an item appropriating \$40,000 for completion of the diversion project at Petersburg, Va., and \$10,000 for maintenance of the general improvement be inserted, if possible, in the pending river and harbor bill. A proviso should be included to the effect that the money so appropriated shall not be available until the work to be done by the city of Petersburg, under the joint agreement of October 10, 1912, is completed and the work to be done by the Norfolk & Western Railway Co., under the same agreement, is actually in progress.

J. R. JERVEY,
Lieutenant Colonel, Corps of Engineers,
United States Army.

[First indorsement.]

OFFICE OF DIVISION ENGINEER, EASTERN DIVISION,
December 23, 1916.

To the CHIEF OF ENGINEERS:

Concurring in the recommendation of the district officer.

W. N. JUDSON,
Lieutenant Colonel, Corps of Engineers,
Division Engineer.

TANGIER CHANNEL, VA.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 107, Sixty-third Congress, first session:

The village of Tangier is located on Tangier Island, Chesapeake Bay, about 15 miles southwest of Crisfield, Md. The principal industry of this island is fishing, oystering, and crabbing, and in this business about 1,000 small sail and gasoline boats, drawing from 2 to 4 feet, are used, which can readily reach

Tangier Sound at all stages of water. The present available depth in the channel leading to Tangier is only about 2 feet at mean low tide, and the improvement desired is a deeper channel, about a mile in length, from Tangier Sound to Tangier, with an anchorage basin at the latter place. Two estimates for this improvement are submitted by the district officer, one covering a channel 4 feet deep and 40 feet wide, with an anchorage basin of the same depth 400 by 400 feet, and the other a channel 5 feet deep and 50 feet wide, with an anchorage basin of the same depth 400 by 400 feet. The 4-foot project is estimated to cost \$12,100 and the 5-foot project \$16,434. He believes that the locality is worthy of improvement to the extent of a channel 4 feet deep at mean low water and 40 feet wide, omitting the suggested anchorage basin, at an estimated cost of \$8,525. The division engineer is of opinion that if this improvement is to be made it would be better to undertake the larger project with the turning basin, at an estimated cost of \$16,434.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its accompanying report of June 3, 1913. In the opinion of the board the amount and value of the commerce of this locality are sufficient to justify the United States in providing some improvement for its benefit, and for reasons stated the board agrees with the division engineer that it would be better to adopt the larger project for a channel 5 feet deep and 50 feet wide, with an anchorage at the upper end 400 by 400 feet of the same depth, at a total estimated cost of \$16,434.

I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and, therefore, in carrying out the instructions of Congress, I report as follows: That the improvement by the United States of Chesapeake Bay with a view to providing a suitable channel at Tangier, Va., is deemed advisable so far as to secure an available channel depth of 5 feet and a channel width of 50 feet, increased at entrances and on curves, from Tangier Sound to Tangier, with an anchorage basin 400 feet by 400 feet of the same depth, following in general the methods described in the report of the district officer, at an estimated cost of \$16,434 for first construction.

Commerce, 1912.

Incoming:	Value.
Coal oil, 18 carloads (about 50,000 gallons) -----	\$4, 540
Wood, 1,000 cords -----	5, 000
Coal, 200 tons -----	1, 600
Building materials -----	10, 000
General merchandise -----	100, 000
Total -----	121, 140
Outgoing:	
Fish, 1,000 tons -----	100, 000
Crabs, hard and soft -----	50, 000
Oysters, 85,000 bushels -----	50, 000
Total -----	200, 000

INLAND WATERWAY FROM NORFOLK, VA., TO BEAUFORT INLET, N. C.

Location and description.—This improvement provides for an inland water route approximately paralleling the Atlantic coast between Norfolk, Va., and Beaufort Inlet, N. C., a distance of 186 statute miles. With the exception of four land cuts, which connect existing watercourses, the route lies in natural waterways. Beginning at Norfolk, Va., it follows successively the Southern Branch of the Elizabeth River, Va., the Virginia Cut of the Albemarle & Chesapeake Canal, North Landing River, Va. and N. C.; Currituck Sound, N. C.; Coinjock Bay, N. C.; the North Carolina Cut of the Albemarle & Chesapeake Canal; and North River, N. C., to Albemarle Sound, a distance of 63.5 miles. The route then crosses Albemarle

Sound from the mouth of North River, N. C., to the mouth of the Alligator River, N. C., a distance of 12.9 miles. Between the southern shore of Albemarle Sound and the mouth of the Neuse River, N. C., it follows successively, the Alligator River, N. C.; a proposed land cut to Rose Bay, N. C., and Pamlico Sound, N. C., a distance of 72.6 miles. Between Pamlico Sound at the mouth of Neuse River and Beaufort Inlet, N. C., the route follows the existing waterway via Neuse River, Adams Creek, Adams Creek Canal, Core Creek, and Newport River to Beaufort Inlet, N. C., a distance of 37 miles.

With the exception of the Southern Branch of the Elizabeth River, the Adams Creek Canal, Core Creek, and Newport River, which are tidal streams, the watercourses followed are nontidal, with very sluggish currents which are due principally to the influence of winds. The width between banks of the various streams in the project is very variable, the widest being 4 miles wide and the narrowest 200 feet wide.

Existing project.—The approved project (H. Doc. No. 391, 62d Cong., 2d sess., with maps) was adopted by the river and harbor act of July 25, 1912, and provides for an inland waterway with a depth of 12 feet at mean low water between Norfolk, Va., and Beaufort, Inlet, N. C., a distance of 186 miles. The bottom widths vary between 90 feet in land cuts to 300 feet in wide waters. The estimated cost of the work is \$5,400,000 for construction only. No estimates were made for maintenance. This waterway is nontidal, except in its extreme northern and southern sections, the tidal range being 2.7 feet at Norfolk, Va., and 2.6 feet at Beaufort Inlet, N. C.

Operations and results during the fiscal year.—Dredging was done in the shoalest parts of the waterway between Norfolk, Va., and Albemarle Sound, N. C., during the year. There were removed during this period 898,416 cubic yards of material by Government plant operated with hired labor, resulting in 2.5 miles of completed channel, and 1,697,594.59 cubic yards of material were removed under three contracts, resulting in 4.4 miles of completed channel. The average cost of the work with Government plant was \$0.1117 per cubic yard, place measurement. The average contract price was \$0.1118 per cubic yard, place measurement. Three highway bridges, carrying public roads across the canal at points where existing roads were intersected by the waterways were completed during the year at a cost of 82,890 for the three bridges. A warehouse for the storage of Government property used in connection with the improvement has been partly completed. The total expenditures for the year, excluding outstanding liabilities, were \$457,979.87, of which \$454,379.87 was for original work and \$3,600 for maintenance. In addition to the above expenditure, the sum of \$500 was applied, by authority of the Secretary of War, to clearing snags and logs from the channel of Pokety Creek, Va., a tributary of the waterway near North Landing, Va., with a navigable length of about 2 miles.

Condition at the end of the fiscal year.—Of the approved project 25.4 per cent has been completed, resulting in 24.5 miles of channel having the project depth of 12 feet at mean low water. The bottom width of 9.5 miles of this completed channel is 90 feet and the bottom width of 15 miles is 250 feet. The maximum depth available throughout the year over the shoalest part of this improvement is 8.5 feet at mean low water. In order to complete the project

24,627,000 cubic yards of dredging, covering a distance of 102 miles, remain to be done. The total expenditures under the existing project to the end of the fiscal year, exclusive of outstanding contracts and liabilities, is \$1,681,439.29, of which \$500,000 was for the purchase of the Albemarle & Chesapeake Canal, \$1,177,839.29 for original work, and \$3,600 for maintenance. In addition to the above expenditure, \$500 has been expended for work on Pokety Creek, a tributary of the waterway.

Local cooperation.—No conditions requiring local cooperation were imposed by the law adopting this project, but a public wharf and warehouse have been erected at Coinjock, N. C., and also at Great Bridge, Va., by the citizens of these places. The cost of these structures is not known.

Effect of improvement.—The work done up to the present time has rendered navigation easier, quicker, and safer upon the improved parts of the waterway, but the improvement has not progressed sufficiently to have any effect on the amount of commerce. It has not been practicable as yet to determine its effects on freight rates, but the abolition of tolls, which went into effect on May 1, 1913, should in time result in lower rates.

Proposed operations.—At the close of the fiscal year ending June 30, 1916, there were \$35,304.85, exclusive of outstanding liabilities, available for expenditure under this project. The river and harbor act approved July 27, 1916, appropriated \$1,000,000 for this work, which made a total of \$1,035,304.85 available for expenditure upon the improvement. It is intended to expend the money available upon the following work:

Contract work:

Dredging in the Virginia Cut of the Albemarle & Chesapeake Canal-----	\$110,000.00
Dredging in North River, N. C.-----	195,000.00
Dredging bar at mouth of North River, N. C.----	75,000.00
Dredging in North Landing River, Va.-----	233,000.00
Dredging in Southern Branch, Elizabeth River, Va.-----	107,000.00

Total for contract work-----	\$720,000.00
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Work with United States plant:

Operation of U. S. pipe-line dredge <i>Currituck</i> , 9 months, in the Virginia Cut of the Albemarle & Chesapeake Canal, at \$10,000 per month---	90,000.00
Operation of U. S. pipe-line dredge <i>Currituck</i> , 9 months, in North Landing River, Va., at \$10,000 per month-----	90,000.00

Total for work with United States plant-----	180,000.00
Contingencies, supervision and administration-----	135,304.85

Total -----	1,035,304.85
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It is expected that agreements will be entered into before December 31, 1916, for all the work which it is proposed to have performed by contract. The funds to be applied to contract work will therefore be pledged before that date. The minimum rate of progress which will be specified in contracts will require the completion of all the work contemplated at a date not later than October 31, 1918. It is estimated that the work proposed to be done with United States plant will require until about December 31, 1917, for its completion.

During the fiscal year ending June 30, 1918, it is proposed to carry on dredging operations by contract and with Government plant upon the part of the waterway between Albemarle and Pamlico Sounds, N. C., in accordance with the following estimate for funds, the items of which are given in the order of their urgency:

Purchase of land for right of way and dumping grounds, between Albemarle and Pamlico Sounds, N. C.-----	\$154, 500
Operation of the hydraulic pipe-line dredge <i>Currituck</i> for 6 months (Jan. 1 to June 30, 1918) on land cut between Albemarle and Pamlico Sounds, N. C., at \$10,000 per month-----	60, 000
Contract dredging on land cut between Albemarle and Pamlico Sounds, N. C.-----	685, 500
Engineering, supervision, and contingencies-----	100, 000
Total -----	1, 000, 000

Recommended modifications of project.—A change from the Rose Bay route to the Pungo River-Goose Creek-Bay River route upon the part of the waterway between the Alligator River and Neuse River, N. C., has been recommended twice, as described in House Document No. 1478, Sixty-third Congress, third session, and House Document No. 1136, Sixty-fourth Congress, first session. This change involves an increase in the estimated cost of the portion of the waterway affected from \$2,270,780 to \$2,391,880.

Commercial statistics.—For the calendar year of 1915 the principal articles of commerce were coal, fertilizer, gasoline, agricultural and forest products, grain, and miscellaneous articles.

Comparative statement.

Year.	Short tons.	Value.
1913-1914 ¹	258, 441	² \$4, 000, 000
1914 ³	229, 047	3, 228, 537
1915 ³	158, 644	4, 316, 776

¹ Statistics reported under "Operating and care of the inland waterway from Norfolk, Va., to Beaufort Inlet, N. C.," for fiscal year ended June 30, 1914, instead of for a calendar year, as the property had not been operated as a free waterway long enough to give the data for a calendar year.

² Values not given in report. Estimate based on values for 1914.

³ Statistics reported under "Operating and care of Inland waterway from Norfolk, Va., to Beaufort Inlet, N. C.," for calendar year.

The decrease in tonnage and increase in value is due principally to decrease in shipments of lumber, logs, and fertilizer and the increased valuation of almost every commodity shipped.

Amount expended on all projects from Mar. 3, 1873, to June 30,

1916:

New work-----	\$1, 972, 104. 63
Maintenance -----	56, 930. 66

Total-----	2, 029, 035. 29
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Balance available for fiscal year ending June 30, 1917-----	1, 035, 304. 85
Amount (estimated) required to be appropriated for completion of existing project-----	2, 600, 500. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement-----	1, 000, 000. 00

MANTEO (SHALLOWBAG BAY), N. C.

Location and description.—Shallowbag Bay, formed by a natural indentation of the shore line, is situated on the northeastern side of

Roanoke Island, N. C. Elizabeth City, N. C., the nearest town, is 45 miles to the northwest, and Norfolk, Va., lies 90 miles north by west.

Condition at end of fiscal year.—The project was completed in September, 1911, for \$3,246.82 less than the estimate. Some deterioration in the dredged channel has occurred, and 5.4 feet at mean low water is the maximum draft that can be carried from Roanoke Sound to the town of Manteo, though dredging operations proposed for July, 1916, will soon restore the project depth. Expended up to June 30, 1916, for improvement, \$10,503.18; for maintenance, \$3,231.88; total, \$13,735.06.

Effect of improvement.—The improvement has had the effect of allowing larger and safer boats to use this bay.

Proposed operations.—The funds available for the fiscal year 1917 will be exhausted about August 10, 1916, by the operations of the U. S. hydraulic pipe-line dredge *Croatan* during July and August, 1916.

1½ months, at \$3,000-----	\$4, 000. 00
Superintendence and contingencies-----	791. 37
Total-----	4, 791. 37

It is not expected that further dredging will be required for three to four years.

It is proposed to apply the amount estimated for the year 1918 to surveys, collecting commercial statistics, and office expenses, \$500.

Commercial statistics.—The commerce for the calendar year 1915 amounted to 12,110 short tons, valued at \$557,551.80, all of which passed over the improved channel. The commerce consisted principally of fish, grain, general merchandise, ice, and machinery, and was transported in gasoline, sail, and steam boats drawing from 3 to 5 feet. No change in character of commerce resulted from improvement and no lines established or abandoned. The increase in tonnage is due to the establishment of an ice plant at Manteo, and the decrease in value due to a lesser quantity of machinery having been received in 1915, and on account of a falling off in the receipts of dry goods, which was probably the result of two bad fishing seasons.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	8,867	\$576,404.50
1914.....	11,888	593,531.50
1915.....	12,110	557,551.80

Amount expended on all projects from June 25, 1910, to June 30, 1916:

New work-----	\$10,503. 18
Maintenance-----	3,231. 88
Total-----	13,735. 06
Balance available for fiscal year ending June 30, 1917-----	4,791. 37
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	500. 00

MANTEO BAY, N. C.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 864, Sixty-third Congress, second session:

Manteo Bay, or Shallowbag Bay, is on the northeastern side of Roanoke Island. By the act of June 25, 1910, a project was adopted for improvement of Shallowbag Bay, providing for a channel 100 feet wide and 6 feet deep at mean low water from the entrance of the bay to the wharves at Manteo. This project has been completed, but some maintenance work will be required to make the project depth available. There is no lunar tide at this locality, but the district officer reports that there are times, especially during the winter, when the depth ordinarily available is lowered by winds, and during such times navigation is practically closed to boats drawing more than $4\frac{1}{2}$ to 5 feet of water. The improvement apparently desired is a channel capable of being used at all times by boats drawing 6 feet of water. The commerce of the locality, which is necessarily entirely by water, has shown a substantial increase as a result of the facilities provided by the United States, and the district officer is of opinion that further improvement is advisable to the extent of dredging an approach channel in Manteo Bay 100 feet wide and 7 feet deep, and a channel or basin 200 feet wide and 7 feet deep to the upper limits of the town of Manteo, at a total estimated cost of \$28,000, provided the right to dredge the marshland within the limits of the basin and to deposit material on adjacent marshland be granted free of cost to the United States. The division engineer concurs with the district officer in believing that the General Government is justified in undertaking the work proposed.

I concur with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Manteo Bay, N. C., is deemed advisable to the extent of providing an approach channel 7 feet deep and 100 feet wide, with a small basin in front of the marine railway, and thence a channel or basin of the same depth and 200 feet wide to the upper limits of the town of Manteo, as shown on accompanying map, at an estimated cost of \$28,000 for first construction and \$2,000 annually for maintenance, provided that no expense shall be incurred by the United States for acquiring any land required for the purpose of this improvement.

THOROUGHFARE BAY, N. C.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1125, Sixty-third Congress, second session:

There are submitted herewith, for transmission to Congress, reports dated October 8, 1913, and April 11, 1914, with map, by Maj. H. W. Stickle, Corps of Engineers, on preliminary examination and survey of Thoroughfare Bay, N. C., from Core Sound to Cedar Bay, near the mouth of Neuse River, Pamlico Sound, authorized by the river and harbor act approved March 4, 1913.

Thoroughfare Bay is on the north side of Core Sound, about 6 miles west of the end of the peninsula at the junction of Core and Pamlico Sounds. The improvement contemplated is the deepening of portions of an existing waterway about $1\frac{1}{2}$ miles in length connecting Thoroughfare Bay and Cedar Bay, which is now used when tides permit by vessels plying between Core Sound and Pamlico Sound. Except when the tides are favorable, these vessels are now obliged to use the route north of Harbor Island, where the depth is also deficient and the passage rough and dangerous. Several small communities, having an aggregate population of about 2,000, principally engaged in fishing and oystering, would be benefited by the desired improvement. The district officer presents a plan which provides for a channel 5 feet deep and 50 feet bottom width, at an estimated cost of \$5,200, and \$300 annually for maintenance. He expresses the opinion that the locality is worthy of improvement to this extent, and the division engineer concurs in this view.

I concur with the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Thoroughfare Bay, N. C., is deemed advisable to the extent of providing a channel 5 feet deep and 50 feet bottom width, connecting Thoroughfare Bay and Cedar Bay, N. C., at an estimated cost of \$5,200 for first construction and \$300 annually for maintenance.

HARBOR OF REFUGE AT CAPE LOOKOUT, N. C.

Location and description.—Cape Lookout is the middle of the three prominent capes on the coast of North Carolina. Cape Hatteras is about 74 miles to the northeast and Cape Fear about 95 miles to the southwest. Wilmington, N. C., is 125 miles distant by water in a southwesterly direction, and Norfolk, Va., is 225 miles northerly. The harbor, which is $1\frac{5}{8}$ by $1\frac{3}{4}$ miles, is formed by a natural indentation of the shore line and by a breakwater.

Existing project.—The existing project, adopted by the river and harbor act approved July 25, 1912, provides for the construction of a harbor of refuge inclosing by means of a rubblestone breakwater an area of 575 acres, of 30 feet or more in depth (H. Doc. No. 528, 62d Cong., 2d sess., with map), at an estimated cost of \$3,526,600. The mean range of tides is 3.7 feet.

Condition at the end of the fiscal year.—The project is 23.1 per cent completed. From a point 1,550 feet offshore to a point 3,400 feet offshore the breakwater is now showing above low water. Expended on present project to June 30, 1916, \$498,303.82, all for new work.

Proposed operations.—The funds available for the fiscal year 1917, including amount covered by uncompleted contracts, will be exhausted by May 30, 1917, as follows:

11 months' contract earnings, at \$70,625-----	\$776, 875. 00
11 months' superintendence and inspection, at \$1,202+-----	13, 225. 36
Total-----	790, 100. 36

It is proposed to apply the total amount estimated for the year 1918 as follows:

To depositing 422,000 tons of stone in breakwater, at \$1.98-----	\$835, 560
To superintendence and inspection, 12 months, at \$1,203-----	14, 440
Total-----	850, 000

Amount expended on all projects from July 25, 1912, to June 30, 1916:

New work-----	498, 303. 82
Maintenance-----	-----
Balance available for fiscal year ending June 30, 1917-----	90, 675. 82
Amount (estimated) required to be appropriated for completion of existing project-----	2, 126, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement-----	850, 000. 00

BEAUFORT HARBOR, N. C.

Location and description.—Located just inside Beaufort Inlet. Cape Fear is about 93 miles to the southeast, Cape Lookout is 8 miles east, and Norfolk, Va., is about 225 miles by ocean route to the north. The harbor is formed behind barrier beach opposite Beaufort Inlet. The general dimensions are $1\frac{1}{2}$ miles by $1\frac{1}{2}$ miles.

Condition at the end of fiscal year.—The project has been completed. The jetties and sand fences at Fort Macon and Shackleford Points are in good condition and have stopped erosion at these places. The Bulkhead Channel has been restored to project depth, so that 7 feet can be carried to Beaufort. Gallants Channel has been restored to project dimensions and affords a 10-foot channel connect-

ing Beaufort with the inland waterway. The channel in front of the town of Beaufort has deteriorated in width. The total expenditures on present project to June 30, 1916, were \$244,084.50, of which \$175,717.76 was for new work and \$68,366.74 was for maintenance.

Effect of improvement.—The effect of the improvement has been to allow boats of deeper draft to reach the wharves at Beaufort, which made possible a regular line of boats between Norfolk, Va., and Beaufort, N. C., and caused a reduction of freight rates.

Proposed operations.—The funds available June 30, 1916, will be exhausted about May 30, 1917.

By operations of dredge <i>Croatan</i> from Mar. 16, 1917, to Apr. 26, 1917, 1½ months, at \$3,000-----	\$4, 000. 00
Purchase tender for new dredge-----	1, 800. 00
Superintendence, etc-----	187. 25
Total -----	5, 987. 25

It is proposed to apply the amount estimated for the year 1918 in operation of U. S. hydraulic dredge *Croatan*, one and one-half months, \$4,500.

Commercial statistics.—The commercial statistics for the calendar year 1915 amounted to 169,712 short tons, valued at \$2,948,604.90, all of which passed over the improved sections of the waterway. It consisted principally of acid phosphate, coal, cement, fertilizer, fertilizer material, general merchandise, and farm and water products. Of the commerce transported, 110,853 tons of acid phosphate, cement, coal, fertilizer material, gravel, lumber, plaster, piling, and railroad iron, valued at \$973,681.40, were carried in barges and schooners drawing from 5 to 9 feet; 392 tons of machinery, railroad iron, piling, crossties, and lumber, valued at \$10,015.20, were carried by scows drawing from 4½ to 13 feet; 58,467 tons of general merchandise, farm and water products, fertilizer, fish oil, gasoline, ice, kerosene, and machinery, valued at \$1,964,908.30.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	85, 423	\$2, 400, 015. 90
1914.....	68, 241	1, 921, 877. 56
1915.....	169, 712	2, 948, 604. 90

No new lines were established during the year. A transportation company doing a barge business between Philadelphia, Pa., and Charleston, S. C., greatly increased its service, which is partly responsible for the increase in tonnage and value.

Amount expended on all projects from July 4, 1836, to June 30, 1916:

New work-----	\$180, 717. 76
Maintenance-----	68, 366. 74
Total -----	249, 084. 50
July 1, 1916, balance available-----	5, 987. 25

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement----- 4, 500. 00

BEAUFORT HARBOR, N. C.—NEW PROJECT.

Report of the Chief of Engineers, printed in Senate Document 1108, Sixty-third Congress, second session:

The existing projects for improvement of Beaufort Harbor provide for a channel from the north 60 feet wide and 10 feet deep at mean low water, a channel from the south 100 feet wide and 7 feet deep at mean low water, and a channel from the east 40 feet wide and 5 feet deep at mean low water. The first two channels mentioned have been completed, and an anchorage area or turning basin 200 feet wide and 2,000 feet long has been constructed in front of the town under authority contained in the river and harbor act of June 25, 1910. The improvement now desired is an enlargement of the anchorage area, which, it is claimed, is congested to such an extent as to endanger the vessels using it. The district officer presents a plan of improvement which provides for a basin 550 feet wide, 10 feet deep at mean low water, and about 2,300 feet long, protected from deterioration by a stone bulkhead, at a total estimated cost of \$53,100. He expresses the opinion that the locality is worthy of improvement to this extent, provided local authorities will construct a suitable public wharf with storage facilities and mechanical equipment and with rail connections. The division engineer is of the opinion that the further improvement of the locality with a view to providing a suitable turning basin and anchorage area in front of the town of Beaufort is not worthy of being undertaken by the General Government at the present time.

The Board of Engineers for Rivers and Harbors does not believe that the United States would be justified in carrying out the expensive project proposed by the district officer, but it is of opinion that it is advisable to provide a moderate enlargement of the existing basin to a depth of 10 feet, covering the triangular area shown on the accompanying map, at an estimated cost of \$15,900.

I concur with the views of the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Beaufort Harbor, N. C., with a view to providing a suitable turning basin and anchorage area in front of the town of Beaufort, is deemed advisable to the extent of excavating to a depth of 10 feet at mean low water the triangular area shown in solid lines on the accompanying map, at an estimated cost of \$15,900 for first construction and \$1,100 annually for maintenance.

BEAUFORT INLET, N. C.

Location and description.—Beaufort Inlet connects Beaufort Harbor with the Atlantic Ocean and is about 3 miles from the town of Beaufort. Cape Fear is about 93 miles to the southwest; Norfolk, Va., is about 225 miles by ocean route to the north.

Existing project.—The existing project, adopted by the river and harbor act of March 3, 1905, contemplates securing a channel 300 feet wide and 20 feet deep at mean low water across the bar, to be obtained by dredging, at an estimated cost of \$45,000 and about \$15,000 annually for maintenance. (H. Doc. No. 563, 58th Cong., 2d sess.) The average rise of tide is 2.5 feet at Beaufort and 3.5 feet at the inlet. For latest map see House Document No. 1454, Sixtieth Congress, second session.

Condition at end of fiscal year.—The project was completed in December, 1910, for \$515.76 less than the estimate and work since then has been for maintenance. Some shoaling in the dredged channel has occurred and at the close of the year the minimum low-water depth was 18½ feet. Expended to June 30, 1916—for new work, \$44,484.24; for maintenance, \$67,839.50; total, \$112,323.74.

Effect of improvement.—As the result of this improvement a regular barge line between Philadelphia, Pa., and Charleston, S. C., has been established.

Proposed operations.—The funds available for the fiscal year 1917 will be exhausted by about December 31, 1916, as follows:

Operations, U. S. dredge <i>Cape Fear</i> , 2½ months, Oct. 15 to Dec. 31, at \$3,950-----	\$9, 875. 00
Superintendence, etc-----	162. 26
Total -----	10, 037. 26

It is proposed to apply the amount estimated as a profitable expenditure in the fiscal year 1918 to maintaining the bar channel by dredging with Government plant and hired labor, as follows:

Operations, dredge <i>Cape Fear</i> , 3½ months, at \$3,950-----	\$13, 825
Superintendence and contingencies-----	175
Total -----	14, 000

The amount estimated as necessary for annual maintenance has been increased from \$10,000 to \$14,000 as it has been found the necessary work can not be carried on with the former amount.

Commercial statistics.—The commerce for the calendar year 1915 amounted to 119,585 short tons, valued at \$1,112,937.60, all of which passed over the improved sections of the inlet. It consisted principally of acid phosphate, coal, cement, fish, fertilizer material, and railroad iron. Of the commerce transported, 101,561 short tons, valued at \$880,761.40, of acid phosphate, cement, coal, fertilizer material, gravel, lumber, plaster, piling, and railroad iron were carried by barges drawing from 8 to 9 feet, towed by tugs drawing from 12 to 14 feet; 392 tons, valued at \$10,015.20, of machinery, railroad iron, piling, crossties, and lumber were carried by scows drawing from 4½ to 11 feet, towed by tugs drawing from 9 to 13 feet; 17,632 tons of fish, valued at \$221,161, was carried by gas boats drawing from 3 to 6 feet. No lines were abandoned during the year and none established, but a transportation company doing business by barge between Philadelphia, Pa., and Charleston, S. C., greatly increased its service during the year.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	27, 275	\$466, 716. 00
1914.....	23, 754	292, 074. 00
1915.....	119, 585	1, 112, 937. 60

The increase in tonnage and value was due to the increased business done by barges operating between Philadelphia, Pa., and Charleston, S. C., due to a great extent to the scarcity of sailing vessels to handle this commerce by an all-ocean route, and also to the large amount of stone being transported through the inlet for the construction of the harbor of refuge at Cape Lookout, N. C.

Amount expended on all projects from Mar. 3, 1905, to June 30.

1916:

New work-----	\$44, 484. 24
Maintenance -----	67, 839. 50

Total-----	112, 323. 74
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July 1, 1916, balance available-----	37.26
Amount appropriated by river and harbor act approved July 27, 1916 -----	10,000.00
Balance available for fiscal year ending June 30, 1917-----	10,037.26
Amount that can be profitably expended in fiscal year ending June 30, 1918. for maintenance of improvement-----	14,000.00

HARBOR AT MOREHEAD CITY, N. C.

Location and description.—Situated on the northern shore of Bogue Sound, Newbern, N. C., is the nearest city of importance, about 43 miles by inland waterway to the northwest; to the north, Norfolk, Va., is about 225 miles by ocean route, and 200 miles by inland waterways. The harbor is formed behind an island of marsh. Its general dimensions are about 1,000 feet by 4,000 feet.

Existing project.—The existing project, adopted by the river and harbor act of June 25, 1910, provides for securing a channel by dredging to a depth of 10 feet at mean low water, beginning at a point 2,000 feet westward of Beaufort Harbor and extending up to the wharves at Morehead City, for a distance of 3,800 feet, the lower 2,800 feet having a width of 100 feet and the upper 1,000 feet a width of 200 feet, at an estimated cost of \$19,000, with \$2,000 annually for maintenance, in accordance with plan (with map) printed in House Document No. 649, Sixty-first Congress, second session. Average rise of tide about 2.5 feet. For latest map see House Document No. 1022, Sixty-third Congress, second session.

Condition at end of fiscal year.—The project was completed in 1913. A mean low-water channel 10 feet deep and 100 feet wide exists from deep water 2,800 feet toward the city; thence a channel of the same depth and 200 feet wide up to the wharves of the city 1,000 feet. Expended on present project up to June 30, 1916, for new work, \$20,291.58; for maintenance, \$5,347.78; total, \$25,639.36.

Local cooperation.—The project for improvement, as adopted by Congress, provided that local interests should construct a bulkhead 500 feet in length in front of Morehead City and cause to be conveyed to the United States the right to deposit between said bulkhead and the shore the material excavated from the channel; and provided further that local interests or the town of Morehead City should provide at least one wharf of adequate facilities, the use of which to be open to all on equal terms. These conditions have been complied with. Approximately one-half mile of concrete sheet-pile bulkhead was built at a cost of about \$30,000, and the conveyance of the right to deposit excavated material therein was accepted by the Chief of Engineers on June 19, 1912. The town of Morehead City executed an agreement (approved by the Secretary of War Jan. 19, 1911) to establish and maintain in perpetuity a public wharf with adequate shipping facilities and to permit all water craft to use the said wharf on equal terms for reasonable rates of compensation. In accordance with this agreement a wharf, costing approximately \$1,200, was built and is being maintained. About \$5,000 has been expended by local interests in dredging to extend the improved channel.

Effect of improvement.—The effect of the improvement has been to allow boats of deeper draft to reach the wharves at Morehead City,

which made possible a regular line of boats between Morehead City, N. C., and Norfolk, Va., and caused a reduction of freight rates.

Proposed operations.—The funds available for the fiscal year 1917 will be exhausted by about September 30, 1916, as follows:

Purchase of equipment dredge <i>Croatan</i>	\$2, 000. 00
Superintendence, surveys, office expenses.....	612. 96
Total.....	2, 612. 96

It is proposed to apply the amount estimated for the fiscal year 1918 to maintenance of the channel by dredging with the U. S. pipeline dredge *Croatan* during March, 1918, as follows:

Operation of U. S. hydraulic dredge *Croatan* two-thirds month, at \$3,000_ \$2, 000

Commercial statistics.—The commerce for the calendar year 1915 amounted to 12,363 short tons, valued at \$678,606.50, all of which passed over the improved sections of the harbor. It consisted principally of clams, fish, ice, potatoes, and soft-shell crabs. Most of the commerce was carried in gas and sail boats drawing from 3 to 5 feet. Tugboats having drafts of 10 to 12 feet, engaged in barge transportation through the inland waterway and Beaufort Inlet, called at Morehead City for fuel, water, and supplies.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	14, 824	\$951, 812. 40
1914.....	17, 828	869, 005. 00
1915.....	12, 363	678, 606. 50

The decrease in tonnage and value was on account of the poor demand for crossties and the small catch of fish and crabs by fishermen in this locality.

Amount expended on all projects from June 25, 1910, to June 30, 1916:	
New work	\$20, 291. 58
Maintenance	5, 347. 78
Total.....	25, 639. 36
Balance available for fiscal year ending June 30, 1917.....	2, 612. 96
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	2,000. 00

ROANOKE RIVER, N. C.

Location and description.—This stream is formed by the junction of the Dan and Staunton Rivers at Clarksville, Va., and flows southeasterly for 198 miles into Albermarle Sound, N. C. The portion under improvement extends from Weldon, N. C., to the mouth, a distance of 129 miles.

Condition at the end of the fiscal year.—War obstructions and some shoals have been removed and the channel has been cleared of logs and snags between the mouth of the river and a point about 5 miles below Weldon. The following least channel depths are available throughout the year: Between the mouth and Hamilton, a dis-

tance of 62 miles, a minimum depth of 10 feet below mean low water, and between Hamilton and a point 2 miles below Weldon, a distance of 65 miles, a minimum depth of 3 feet below mean low water. The project is 80 per cent completed. The total expenditures under the project, exclusive of outstanding liabilities, are \$245,253.34, of which \$228,435.62 was for original work and \$16,817.72 for maintenance.

Effect of improvement.—Navigation has been rendered easier and safer. It has not been practicable to determine the effect, if any, of the improvement on freight rates.

Proposed operations.—It is proposed to continue maintenance work by dredging and snagging with Government plant and hired labor, as necessary. On June 30, 1916, there was an unexpended balance of \$2,108.16 available for this project. During the past 10 years maintenance work has been done during six years at an average annual cost for the 10 years of about \$1,700, with a maximum expenditure of \$2,495 for the most costly year and a minimum expenditure of \$1,616 for the least expensive year. No maintenance work has been done during the past two years, and the river now needs attention. It is, therefore, probable that the funds now on hand will be exhausted by June 30, 1917. The following estimate is submitted for the year ending June 30, 1918, to provide for the maintenance of the improved condition of the river:

Operating U. S. snagboat <i>Roanoke</i> 3 months, at \$600 per month-----	\$1,800
Supervision and contingencies-----	700
Total-----	2,500

No estimate for completing the project is submitted, as the present dimensions, if maintained, are considered adequate for the class of commerce now using the stream.

Commercial statistics.—During the calendar year 1915 the principal items of commerce on this stream were logs, lumber, and farm products.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	74,322	\$2,984,560
1914.....	72,421	2,144,249
1915.....	88,295	2,226,858

Amount expended on all projects from Mar. 3, 1871, to June 30, 1916:

New work-----	\$228,435.62
Maintenance-----	16,817.72
Total-----	245,253.34

July 1, 1916, balance unexpended-----	2,108.16
Amount (estimated) required to be appropriated for completion of existing project-----	38,400.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	2,500.00

SCUPPERNONG RIVER, N. C.

Location and description.—This river rises in the center of a peninsula between Albemarle and Pamlico Sounds. It flows in a general northerly direction, making a long bend eastward to the town of

Columbia, then turning westward again until it flows into Albemarle Sound. Its length is about 30 miles and its drainage area is about 182 square miles.

Condition at the end of fiscal year.—The project was completed in November, 1909, for \$751.32 less than the estimate. A channel 9 feet deep and 150 feet wide exists on the bar at the mouth; thence to Cross Landing, 14 miles above, a good open channel of 7 feet free from obstructions; thence to Spruills Bridge, 9 miles farther, 7 feet at mean low water, but the river in many places is narrow and crooked and obstructed by overhanging trees on the banks and by logs and snags in the channel. Expended on present project to June 30, 1916, for improvement, \$13,248.68; for maintenance, \$12,114.38; total, \$25,363.06.

Effect of improvement.—The improvement has had the effect of reducing freight rates and enabling deeper draft vessels to use the river.

Proposed operations.—Maintenance work is required on this stream about every three years, and the amount estimated for the fiscal year 1918 is to be used in conjunction with the money available June 30, 1916, to do the necessary dredging in October and November, 1917.

On June 30, 1916, there was available \$1,408.85, which will be exhausted about October 15, 1917, as follows: For maintenance of bar channel by dredging with U. S. dredge *Croatan*—

Fourteen-thirtieths month, Oct. 17–30, 1917, at \$3,000-----	\$1, 400. 00
Superintendence -----	8. 85
Total-----	1, 408. 85

It is proposed to apply the amount estimated for the fiscal year 1918 to the maintenance of the bar channel by dredging with the U. S. dredge *Croatan*, as follows:

1 month, Oct. 16 to Nov. 15, at \$3,000-----	\$3, 000
Superintendence, surveys, and commercial statistics-----	500
Total-----	3, 500

Commercial statistics.—The commerce for the calendar year 1915 amounted to 9,448 short tons, valued at \$389,478.30, of which amount 8,624 tons, valued at \$356,406.30, passed over the improved section of the river. The principal items were cotton, eggs, fertilizer, general merchandise, timber, and farm products. General merchandise and farm products are carried by gasoline and sail boats drawing from 3 to 5 feet; coal, fertilizer, lime, etc., are handled by barges drawing from 6 to 8 feet. The decrease in tonnage below that of last year is due the closing down of a lumber mill. The increase in the value of the commerce is due to increased shipments of cotton.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	30, 073	\$382, 622. 50
1914.....	27, 224	355, 370. 50
1915.....	9, 448	389, 478. 30

Amount expended on all projects from Mar. 3, 1879, to June 30, 1916:

New work-----	\$21, 248. 68
Maintenance -----	12, 114. 38
Total -----	33, 363. 06
July 1, 1916, balance available-----	1, 408. 85
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	3, 500. 00

SCUPPERNONG RIVER, N. C.—NEW PROJECT.

Abstract from the report of the Chief of Engineers printed in House Document 1196, Sixty-second Congress, third session:

Scuppernong River, on the southern shore of Albermarle Sound, has been under improvement by the United States since 1876, under projects providing for dredging the bar, making cut-offs at sharp bends, and removing obstructions from the channel up to Spruills Bridge, the landing for the village of Creswell, 23 miles above the mouth. Cherry, 26 miles from its mouth, is head of navigation, to which point 5 feet can be carried at mean low water. Existing depths in the stream appear to be ample for the boats now using it, but above Cross Landing navigation is rendered difficult on account of the bends and obstructions.

The district officer submits with favorable recommendation a plan for further improvement contemplating (a) a channel 150 feet wide on bottom and 10 feet deep at mean low water across the bar, and a channel 100 feet wide on bottom and 10 feet deep from the bar up to and including the town of Columbia; (b) a channel 40 feet wide on bottom and 8 feet deep from Columbia to Spruills Bridge near Creswell, including several cut-offs; (c) a channel 30 feet wide on bottom and 7 feet deep from Spruills Bridge to the fixed highway bridge near Cherry, involving work at about 20 points, and a turning basin of a triangular plan 150 feet wide on a side 7 feet deep over the entire triangular area near Cherry bridge at the mouth of Mauls Creek, at a total estimated cost of \$31,800 and \$1,000 annually for maintenance. The division engineer concurs in recommending this improvement.

I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore, in carrying out the instructions of Congress, I report as follows: That the improvement by the United States of Scuppernong River, N. C., is deemed advisable so far as to secure an available channel depth of 10 feet and a channel width of 150 feet across the bar at the mouth; thence 100 feet wide and 10 feet deep to Columbia; thence 40 feet wide and 8 feet deep to Spruills Bridge; thence 30 feet wide and 7 feet deep to the highway bridge near Cherry, and the construction of a turning basin near Cherry, following in general the methods described in the report of the district officer at an estimated cost of \$31,800 for first construction and \$1,000 annually for maintenance.

PAMLICO AND TAR RIVERS, N. C.

Location and description.—The two names are applied to the same river, it being known as the Pamlico below Washington, N. C., and as the Tar above that point. This stream rises in Person County, flows in a general southeasterly direction for 217 miles, and empties into Pamlico Sound. The stream is about $4\frac{1}{2}$ miles wide at the mouth, 1 mile in width at Washington, 300 feet at Greenville, and 220 feet at Tarboro.

Condition at end of fiscal year.—The project was completed in 1915. A channel 200 feet wide and 10 feet deep exists to Washington, giving an increase of 100 feet in width and 1 foot in depth over what was previously available. There has been some deterioration in the 6-foot dredged channel to Greenville, so that the limiting depth is

now 4 feet. Between Greenville and the mouth of Fishing Creek the stream is clear of snags. The expenditures under the existing project to June 30, 1916, amounted to \$222,880.73 for new work and \$36,983.30 for maintenance, making a total of \$259,864.03.

Effect of improvement.—The effect of the improvement has been to lower freight rates and to allow vessels of deeper draft to reach Washington, N. C. Above Washington it has provided a more economical and convenient way for the handling of farm products, fertilizer, etc.

Proposed operations.—The funds available for fiscal year 1917 will be exhausted by about November, 1916, as follows:

Maintaining improvement below Greenville by operation of U. S. hydraulic dredge <i>Croatan</i> , 2 months, at \$3,000-----	\$6, 000. 00
Maintaining improvement between Greenville and Fishing Creek by operation of U. S. snag boat <i>Contentnia</i> , during October, 1916, 1 month, at \$500-----	500. 00
Superintendence, etc-----	227, 86
Total-----	6, 727. 86

It is proposed to apply the amount estimated for the fiscal year 1918 as follows:

Maintaining improvement below Washington by operation of U. S. dredge <i>Croatan</i> , 1 month, at \$3,000-----	\$3, 000. 00
Maintaining improvement between Greenville and Fishing Creek by operation of U. S. snag boat <i>Contentnia</i> , 2 months-----	1, 000. 00
Superintendence, etc-----	500, 00
Total-----	4, 500. 00

Commercial statistics.—The commerce for the calendar year 1915 amounted to 286,716 short tons, valued at \$3,937,502.40, all of which passed over the improved sections of the waterway. It consisted principally of cotton, fish, fertilizer, fertilizer material, grain, general merchandise, lumber, and machinery.

Of the commerce transported 106,795 tons of coal, fertilizer, fertilizer material, gravel, and lumber, valued at \$1,279,788 were carried by schooners and barges drawing from 6 to 9 feet; 43,931 tons of general merchandise, farm and water products, etc., valued at \$2,249,744.40, were carried by sail, gas, and steam boats drawing from 3 to 5 feet; 135,990 tons of timber, valued at \$407,970, was rafted and carried on flats drawing from 4 to 7 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	322,364	\$5,429,622.50
1914.....	288,827	3,635,611.37
1915.....	286,716	3,937,502.40

There was no change in the character of commerce resulting from improvement. One new line was established during the year. The decrease in tonnage was caused by lumber mills handling more of their timber by rail and on account of the poor demand for poles, piles, wood, crossties, etc.; the increase in value was caused by the greater demand for lumber, which caused an increase in price and in shipments; the increase in price of fertilizer and fertilizer material, caused by the European war, and due also to a larger cotton

crop. A decrease in tonnage but an increase in value was on account of a falling off in shipments of commodities of a low value per ton and an increase in shipments and price of commodities of a high value per ton.

Amount expended on all projects from July 4, 1836, to June 30,

1916:

New work-----	\$301, 680. 73
Maintenance -----	53, 454. 41
Total -----	355, 135. 14
Balance available for fiscal year ending June 30, 1917-----	6, 727. 86
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	4, 500. 00

CONTENTNIA CREEK, N. C.

Location and description.—Contentnia Creek rises in Wilson County, N. C., flows in a general southeasterly direction and empties into Neuse River about 32 miles above Newbern, N. C. Its length is about 144 miles.

Existing project.—The existing project was adopted by the river and harbor act of March 3, 1881 (H. Doc. No. 85, 46th Cong., 3d sess., and Annual Report for 1881, p. 1010), and contemplated clearing the stream of obstructions so as to obtain from its mouth to Stantonsburg a depth of not less than 3 feet during the higher stages about nine months of the year, at a cost estimated in 1888 at \$77,500. It was amended in 1894 to limit maintenance below Snow Hill and extended in 1899 to include maintenance to Stantonsburg. For map of this stream, see Annual Report for 1887, page 1014.

Condition at end of fiscal year.—The project was completed in 1896 for \$13,105.44 less than the estimate of 1888. Since that time work has been confined to maintenance principally below Fools Bridge. A channel free from obstructions and 3 or 4 feet deep exists for from six to eight months during the year to Fools Bridge, 42 miles. Above that point the stream is in poor condition. Expended on present project to June 30, 1916: For improvement, \$64,394.56, and for maintenance, \$19,532.33; a total of \$83,926.89.

Effect of improvement.—The effect of the improvement has been to open up a more convenient and economical way to dispose of farm products and receive fertilizer, saving a long haul by wagon to and from the railroads.

Proposed operations.—The funds available June 30, 1916, will be exhausted about March 30, 1917, by snagging with U. S. hoister *Contentnia* and hired labor during February and March, 1917.

2 months, at \$450-----	\$900. 00
Superintendence, etc-----	173. 11
Total -----	1, 073. 11

It is proposed to apply the amount estimated for the year 1918 to maintenance of the natural channel by snagging with the hoister *Contentnia* and hired labor during the months of February and March, 1918, as follows:

Operation of hoister <i>Contentnia</i> , 2 months, at \$450-----	\$900
Superintendence and contingencies-----	100
Total -----	1, 000

Commercial statistics.—The commerce for the calendar year 1915 amounted to 9,607 short tons, valued at \$146,975, all of which passed over the improved sections of the stream. It consisted principally of cotton, cotton seed, fertilizer, and timber. All of the commerce was carried in steamers drawing from 3 to 4 feet, except timber, which was rafted.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	8,684	\$196,320.00
1914.....	7,669	108,523.50
1915.....	9,607	146,975.00

The increase in tonnage and value is due to the greater demand for timber at the close of the year and to the favorable stage of water for boating at the time the cotton crop was ready for shipment.

Amount expended on all projects from Mar. 3, 1881, to June 30, 1916:

New work.....	\$64,394.56
Maintenance.....	19,532.33
Total.....	83,926.89

July 1, 1916, balance unexpended.....	1,073.11
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	1,000.00

NEUSE AND TRENT RIVERS, N. C.

(A) NEUSE RIVER.

Location and description.—Neuse River is a tributary of Pamlico Sound. It rises in the northern part of North Carolina and flows in a southeasterly direction until it reaches Kinston; its direction then changes to the northeast until it reaches the mouth of Contentnia Creek, when it again changes to the southeast and continues so for 20 miles past Newbern, when it again changes to the northeast and continues so until it flows into Pamlico Sound at its southern extremity. Its total length is about 350 miles.

Existing project.—The original project of 1871 (adopted by the river and harbor act of June 18, 1878), as extended in 1878–79 and 1880 and continued to date, provides for an 8-foot navigation up to Newbern during the entire year, 4 feet to Kinston, and during nine months of the year 3 feet to Smithfield, by the removal of war obstructions, dredging, jettying, and snagging, at a total estimated cost of \$374,000; extended in 1902 (H. Doc. No. 317, 54th Cong., 2d sess.) to include dredging a channel 300 feet wide below Newbern and 200 feet wide at Newbern to a depth of 8 feet at dead low water, at an estimated additional cost of \$59,081.25. (Annual Report for 1897, p. 1427.) Since its adoption, this additional estimate has been reduced to \$24,000. Length of section included in the project, about 160 miles. The stream is nontidal, variations in the water surface at and below Newbern, due to prevailing winds, seldom exceed 2 feet above or below mean stage.

Condition at end of fiscal year.—The improvement above Newbern is completed to the practical limit of existing project. At dead low

water 8 feet can be carried to Newbern; at mean low water, 4 feet to Biddles Landing, $27\frac{1}{2}$ miles above; $2\frac{1}{2}$ feet to the mouth of Contentnia Creek, $31\frac{1}{2}$ miles above Newbern; and 1 foot to Seven Springs, 75 miles above Newbern, above which point the river is navigable only on freshet stages of 2 to 3 feet, which prevail from six to eight months during the year. The channel is 300 feet wide below Newbern, 200 feet wide at Newbern, and 50 feet wide above. Expended on present project to June 30, 1916: For new work, \$369,399.45; for maintenance, \$60,733.13; total, \$430,132.58.

Effect of improvement.—The effect of the improvement has been to reduce freight rates and to open up a more economical and convenient way to ship farm products, fertilizer, etc.

Proposed operations.—The funds available for the fiscal year 1917 will be exhausted by about April 30, 1917. It is proposed to apply these funds as follows:

Operation dredge <i>Croatan</i> , November and December, 1916, and January, 1917, 3 months, at \$3,000-----	\$9,000.00
Operation hoister <i>Contentnia</i> , December, 1916, and April, 1917, 2 months, at \$500-----	1,000.00
Superintendence and contingencies-----	143.36
Total-----	10,143.36

It is proposed to apply the amount estimated for the year 1918 to snagging above Newbern and dredging below Newbern, as follows:

Operation hoister <i>Contentnia</i> , 3 months, at \$500-----	\$1,500
Superintendence and contingencies-----	500
Total-----	2,000

Commercial statistics.—The commerce for the calendar year 1915 amounted to 429,590 short tons, valued at \$6,240,511.35, of which 323,182 tons, valued at \$5,016,227.60, passed over the improved sections of the stream. It consisted principally of cotton, cotton seed, cement, coal, fertilizer, general merchandise, lumber, piles, railroad iron, and timber.

Of the commerce transported 292,018 tons of coal, cement, fertilizer, fertilizer material, lumber, and piles, valued at \$3,350,679, were carried by barges and schooners drawing from 6 to 9 feet; 44,674 tons of general merchandise, farm produce, etc., valued at \$2,611,138.35, were carried by gas, sail, and steam boats drawing from 3 to 5 feet; 92,898 tons of timber, valued at \$278,694, was rafted and carried in scows drawing from 4 to 7 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	443,957	\$7,023,987.00
1914.....	333,833	4,805,197.56
1915.....	429,590	6,240,511.35

The increase in tonnage and value was caused by the increase in barge traffic through the inland waterway, due to some extent to the scarcity of sailing vessels for handling this commerce by an all-ocean route, and to the greater demand and higher prices for lumber, to good crops and better business conditions.

Amount expended on all projects from 1871 to June 30, 1916:

New work	\$369,399.45
Maintenance	60,733.13
Total	430,132.58
Balance available for fiscal year ending June 30, 1917.....	10,143.36
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	2,000.00

(B) TRENT RIVER.

Location and description.—The stream is formed by the junction of Beaver Dam and Tuckahoe Creeks, in Jones County, N. C. It flows for 80 miles (about 40 miles in an air line) in an easterly direction through Jones and Craven Counties and at Newbern empties into the Neuse River, being its principal tributary.

Existing project.—The existing project is to provide a channel 8 feet deep at dead low water at Newbern, a channel 6 feet deep at dead low water over Foys Flats, and a channel 50 feet wide and 4 feet deep at low water to Trenton. The project for this section of the river at Newbern was adopted in 1902 (H. Doc. 121, 56th Cong., 2d sess.), and provided for securing a channel 8 feet deep at dead low water from the harbor line to the channel at Newbern, at an estimated cost of \$24,000. By joint resolution approved March 4, 1907, authority was given to expend such portion of the appropriation made in river and harbor act of March 2, as might be necessary for securing a channel 6 feet deep over Foys Flats, 4 miles above Newbern. The river and harbor act of June 25, 1910, authorized the dredging of a channel 4 feet deep from Newbern to Trenton and removing obstructions, stumps, and bank snags at an estimated cost of \$15,000, with \$2,000 annually for maintenance after completion. (H. Doc. No. 1471, 60th Cong., 2d sess.; no map.) The length of the section included in the project is 38 miles.

Conditions at the end of fiscal year.—The project below Trenton was completed in September, 1914, and has resulted in increasing the depth from 3 to 4 feet at mean low water. While the width was increased from 40 to 50 feet, 4 feet can be carried at mean low water to Trenton, and 6 feet at dead low water (9.3 feet at mean low water) to Polloksville. Some deterioration has occurred in the 3 miles below Trenton, so that the full project width is not now available. Expended on the present project to June 30, 1916, for improvement, \$39,411.48; for maintenance, \$2,203.87; total, \$41,615.35.

Effect of improvement.—The effect of the improvement has had a favorable effect on freight rates and affords a convenient and economical way for the handling of farm products, etc. It also affords transportation facilities to the town of Trenton, which has no other outlet except by wagon.

Proposed operations.—The funds available June 30, 1916, will be exhausted about October 1, 1916. It is proposed to apply existing funds to the maintenance of the channel by snagging, as follows:

Operation of U. S. hoister <i>Contentnia</i> , July and August, 1916, 2 months, at \$500 per month.....	\$1,000.00
Superintendence and contingencies.....	124.26
Total.....	1,124.26

It is proposed to apply the amount estimated for the year 1918 to maintenance of the channel by snagging and dredging, as follows:

Operation of snag boat <i>Contentnia</i> , August and September, 1917, 2 months, at \$500-----	\$1, 000
Operating dredge <i>Croatan</i> , June, 1918, 1 month-----	3. 000
Total-----	4, 000

Commercial statistics.—The commerce for the calendar year 1915 amounted to 183,611 short tons, valued at \$3,578,289.70, all of which passed over the improved sections of the waterway. It consisted principally of cotton, cotton seed, general merchandise, lumber, and timber. Of the commerce transported, 76,321 tons of lumber, coal, gravel, and fertilizer, valued at \$815,389.50, were carried in barges and schooners, drawing from 7 to 9 feet; 53,965 tons of general merchandise, farm and water products, valued at \$2,602,925.20, were carried by sail, steam, and gasoline boats, drawing from 2 to 4 feet; 53,325 tons of timber, valued at \$159,975 were rafted.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	179, 772	\$1, 345, 258. 60
1914.....	137, 409	2, 731, 447. 00
1915.....	183, 611	3, 578, 289. 70

No new lines were established, the increase in tonnage and value being caused by the large demand and higher prices for lumber and timber, good cotton crop, and better business conditions for the greater part of the year.

Amount expended on all projects from Mar. 3, 1879, to June 30, 1916:

New work-----	\$110, 316. 88
Maintenance -----	29, 308. 86
Total-----	139, 625. 74

July 1, 1916, balance unexpended-----	1, 124. 26
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	4, 000. 00

INLAND WATERWAY FROM PAMLICO SOUND TO BEAUFORT INLET, N. C.

Location and description.—This waterway connects Adams Creek (a tributary of Neuse River) with Core Creek (a tributary of Newport River). The length of the waterway from the 10-foot mean low-water contour in Adams Creek to the 10-foot mean low-water contour in Newport River is about 18 miles.

Existing project.—The existing project under this title, adopted by the river and harbor act of March 2, 1907, contemplates securing by dredging a channel 10 feet deep at low water from Pamlico Sound to Beaufort Inlet, via Adams and Core Creeks, said channel to have a minimum bottom width of 90 feet through dry land, with side slopes of 1 to 2½, a minimum bottom width of 125 feet, with side slopes of 1 to 3 through narrow parts of the creek and river portions, and a minimum bottom width of 250 feet, with side slopes of 1 to 3 in wide

parts of creeks and sounds, at an estimated cost of \$550,000, including the construction of a highway bridge over the waterway. (See H. Doc. No. 84, 59th Cong., 2d sess., with map.) This waterway is also now included in the 12-foot project for "Inland waterway from Norfolk, Va., to Beaufort Inlet, N. C." (see p. 522 of this report). Range of tides: Lunar tide of 3.5 feet at Core Creek end, wind tide of 2.9 feet at Adams Creek end.

Condition at end of fiscal year.—The project was completed in 1911 for \$47,921.37 less than the estimate, the result being a through waterway of 10 feet depth at mean low water where shallow creeks and dry land formerly existed. The project dimensions are available at the close of the fiscal year, but past experience has shown the necessity for annual maintenance dredging at certain localities. Expended on project to June 30, 1916: For new work, \$502,078.63; for maintenance, \$25,099.24; total, \$527,177.87.

Effect of improvement.—The effect of the improvement has been to reduce freight rates. It has also caused the establishment of a regular barge line between Philadelphia, Pa., and Charleston, S. C., and a gas-boat line between Norfolk, Va., and Beaufort and Morehead City, N. C., and several regular lines between Newbern and points south of the waterway.

Proposed operations.—The funds available for the fiscal year 1917 will be exhausted by June 30, 1917, as follows:

Operation of dredge <i>Croatan</i> , Feb. 1 to Mar. 15, at \$3,000-----	\$4, 500. 00
Operating Core Creek drawbridge 12 months, at \$105-----	1, 260. 00
Maintenance of drawbridge-----	740. 00
Part payment equipment for dredge <i>Croatan</i> -----	2, 536. 46
Total-----	9. 036. 46

It is proposed to apply the estimate recommended for the year 1918 to maintaining the channel by dredging, to dredging a new channel through the proposed new location of the Norfolk-Southern drawbridge near Morehead City, and to maintenance and operation of the drawbridge, all by United States plant and hired labor, as follows:

Operation U. S. hydraulic dredge <i>Croatan</i> 4½ months, at \$3,000 per month-----	\$12, 600
Operation Core Creek drawbridge 12 months, at \$105-----	1, 260
Maintenance of drawbridge-----	740
Engineering and contingencies-----	400
Total-----	15, 000

The estimate for maintenance for the year 1918 is increased to provide funds to deepen the channel to the proposed new location of the Norfolk-Southern Railroad drawbridge in the trestle between Morehead City and Beaufort, N. C., as follows: 66,000 yards material dredged, at 10 cents, \$6,600.

Commercial statistics.—The commerce for the calendar year 1915 amounted to 140,093 short tons, valued at \$2,162,199.15, all of which passed over the improved sections of the waterway. It consisted principally of cement, coal, fertilizer, general merchandise, lumber, piling, and railroad iron. Of the commerce transported, 110,853 tons of coal, cement, fertilizer material, gravel, lumber, piles, plaster, and railroad iron, valued at \$973,681.40, were carried in barges

drawing from 8 to 9 feet; 132,811 tons of general merchandise, farm produce, etc., valued at \$1,349,023.85, were carried by gas, sail, and steam boats drawing from 2 to 5 feet; 6,069 tons of timber, valued at \$18,207, were carried on scows drawing from 4 to 7 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	57,457	\$1,285,394.63
1914.....	41,617	1,055,078.56
1915.....	140,093	2,162,199.15

No new lines were established during the year, but a transportation company doing a barge business between Philadelphia, Pa., and Charleston, S. C., greatly increased its service, which is responsible for the increase in tonnage and value over last year.

Amount expended on all projects from Mar. 2, 1907, to June 30, 1916:

New work	\$502,078.63
Maintenance	25,099.24
Total	<u>527,177.87</u>

Balance available for fiscal year ending June 30, 1917.....	9,036.46
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	15,000.00

NORTHEAST AND BLACK RIVERS, N. C.

(A) NORTHEAST RIVER, N. C.

Location and description.—Northeast River rises in the northern part of Duplin County and flows 130 miles in a general southerly direction, emptying into the Cape Fear River at Wilmington, 30 miles above its mouth. This stream has a drainage area of about 1,600 square miles. It is partly tidal. The length of tidal reach, mouth to a short distance above Bannermans Bridge, about 50 miles.

Existing project.—The original and existing project was adopted by the river and harbor act of September 19, 1890, and included the clearing of the natural channel for small steamers to Hallsville and for pole boats to Kornegays Bridge, total length 103 miles, at an estimated cost of \$30,000. (H. Ex. Doc. No. 35, 51st Cong., 1st sess., with map, and Annual Report for 1890, p. 1181.) The project was completed in 1896; work since that date has been for maintenance only. There is a tidal range of about $2\frac{1}{2}$ feet at the mouth of this stream, which decreases to nothing a short distance above Bannermans Bridge. The upper portion is subject to freshets of from 8 to 12 feet.

Condition at end of fiscal year.—The project was completed in 1896 for \$19,312.04 less than the estimate. The lower 56 miles is in fair condition, but there are some snags that should be removed. The upper 47 miles, over which navigation is not practicable at low stages, is badly in need of snagging. Expenditures on present project up

to June 30, 1916, were for new work, \$10,687.96; for maintenance, \$29,265.06; total, \$39,953.02.

Effect of improvement.—The effect of the improvement has been to open up a more convenient and economical way to handle farm products, fertilizer, etc., and has been one cause of large lumber mills being established on the river.

Proposed operations.—The funds available for the fiscal year 1917 will be exhausted about March 1, 1917. It is proposed to apply the funds available to the operation of a Government hoister for six months, at \$500 per month, in snagging for maintenance only, \$3,000; superintendence, etc., \$246.98; total, \$3,246.98.

It is proposed to apply the \$3,000 estimated for the year 1917–18 to the operation of a Government hoister for six months, at \$500 per month, in snagging for maintenance only, below Chinquapin.

Commercial statistics.—The commerce for the calendar year 1915 amounted to 69,116 short tons, valued at \$1,263,962.10, of which 42,073 tons, valued at \$707,587.10, passed over the improved sections of the river. The commerce consisted principally of cotton, cotton seed, fertilizer, fertilizer material, general merchandise, and timber. About 26,000 tons of fertilizer material and phosphate rock, valued at \$556,375, were carried by steamships drawing 16 feet and by schooners drawing 12 to 15 feet. The balance of the commerce was carried by small steamers drawing 3 to 4 feet and by lighters towed by gasoline boats.

Comparative statement.

Calendar year.	Tonnage.	Value.
1913.....	123, 170	\$1, 848, 558. 60
1914.....	128, 518	2, 116, 210. 10
1915.....	68, 116	1, 263, 962. 10

The decrease in tonnage and value is due principally to the falling off in shipments of fertilizer material and lumber.

Amount expended on all projects from Sept. 19, 1890, to June 30, 1916:	
New work	\$10, 687. 96
Maintenance	29, 265. 06
Total	39, 953. 02
Balance available for fiscal year ending June 30, 1917.....	3, 246. 98
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	3, 000. 00

(B) BLACK RIVER, N. C.

Location and description.—Black River rises in Sampson County, flows 175 miles in a general southeasterly direction, and empties into Cape Fear River 14 miles above Wilmington and 44 miles above the mouth.

Existing project.—The original and existing project was adopted by the river and harbor act of August 5, 1886, and included clearing the natural channel and banks to Lisbon, and the cutting off of a few sharp points at bends, at an estimated cost of \$10,000. (Annual Report for 1885, pp. 1145–1154.) It was amended in May, 1893, by

omitting that part of the river above Clear Run, and, as amended, was completed September 20, 1895. Additional work since that date has been for maintenance only. There is a tidal range of about $1\frac{1}{2}$ feet at the mouth, which decreases to nothing 30 miles above. The low-water stages prevail usually from May until August, inclusive; during the rest of the year the stage is about 5 to 8 feet higher, but the periods of high and low water are by no means the same every year.

Condition at end of fiscal year.—The project was completed in 1895 and has been maintained since that time. The river is in good condition, the governing low-water depth being 5 feet to Point Caswell, $2\frac{1}{2}$ feet to Hawes Narrows, 32 miles above the mouth, and $1\frac{1}{2}$ feet to Clear Run. Expenditures on present project up to June 30, 1916, were: For new work, \$12,358.40; for maintenance, \$22,767.18; total, \$35,125.58.

Effect of improvement.—The effect of the improvement has been to open up a more convenient and economical way to handle fertilizer, general merchandise, and farm products, and has been one cause of lumber mills being established along the river.

Proposed operations.—The funds available for the fiscal year 1917 will be exhausted about June 30, 1917. It is proposed to apply the funds available to the operation of a Government hoister for four months, at \$500 per month, in snagging for maintenance only, \$2,000; superintendence, etc., \$325.77; total, \$2,325.77.

It is proposed to apply the \$2,000 estimated for the year 1917–18 to the operation of a Government hoister for four months, at \$500 per month, in snagging, for maintenance only.

Commercial statistics.—The commerce for the calendar year 1915 amounted to 22,534 short tons, valued at \$312,255.70, all of which passed over the improved sections of the stream. It consisted principally of cotton seed, fertilizer, general merchandise, lumber, and timber. The limit of draft for loaded boats, 2 to 4 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	16,047	\$376,983.00
1914.....	8,089	139,122.50
1915.....	18,746	399,143.40

The increase in tonnage was due to increased shipments of lumber and timber; the decrease in value was due principally to the decrease in the shipment of basket bottoms.

Amount expended on all projects from Aug. 5, 1886, to June 30, 1916:

New work	\$12,358.40
Maintenance	22,767.18
Total	<u>35,125.58</u>

Balance available for fiscal year ending June 30, 1917.....	2,325.77
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	2,000.00

NORTHEAST CAPE FEAR RIVER, N. C.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document No. 1356, Sixty-second Congress, third session:

Northeast Cape Fear River lies in the drainage area of the Cape Fear River and rises in the northeast part of Duplin County and flows in a general southerly direction a distance of 130 miles, emptying into the Cape Fear River at Wilmington. The projected depth is not in excess of the depth obtained in Cape Fear River.

The existing project for its improvement provides for clearing the natural channel for small steamers to Hallsville, 88 miles above Wilmington, and for pole boats to Kornegays Bridge, a further distance of 15 miles. It appears that there is no urgent demand for greater navigation facilities throughout the stream, and the district officer is of opinion that no enlargement of this project would be justified by the benefits to be expected. The lower part of the river for a distance of about $1\frac{1}{4}$ miles is included in the present project for improvement of Cape Fear River at and below Wilmington, which provides for a depth of 26 feet. Considerable interest has been manifested in securing an extension of deep water for a further distance of about $1\frac{1}{2}$ miles. On this stretch are located several important fertilizer factories, having a combined commerce estimated at 113,700 tons, valued at \$1,311,800, for the calendar year 1912. Of the above, about 34,000 tons of phosphate rock now comes by rail, but the district officer states that a depth of 20 or 22 feet to these factories would enable them to receive this rock by water at a saving of about 30 cents per ton, and also enable them to save the cost of transporting about 35 per cent of other material from Wilmington to the factories by rail or lighters. The district officer submits an estimate of cost of a channel 150 feet wide and 22 feet deep, in the sum of \$50,750, and an estimate for a channel of similar width and 20 feet deep, in the sum of \$37,000. He expresses the opinion that the present and prospective commerce justifies the improvement by the General Government in accordance with the first plan. The division engineer believes that if the improvement is undertaken, greater channel width should be given.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to the board's accompanying report of January 13, 1913. The board states that the three fertilizer factories now have a considerable tonnage that would be affected by a more commodious channel, and that such a channel would result in a material saving in the handling of their heavier commodities. It appears that these concerns would be directly benefited, while the general public would be indirectly benefited by the work. After mature consideration the board reports that, in its opinion, it is advisable for the United States to undertake the construction of a channel 150 feet wide and 22 feet deep, as proposed by the district officer, provided local or other interests will contribute one-half the cost of first construction.

I concur in general with the views of the Board of Engineers for Rivers and Harbors, and therefore, in carrying out the instructions of Congress, I report as follows: That the improvement by the United States of Northeast Cape Fear River, N. C., is deemed advisable so far as to secure an available channel depth of 22 feet and a channel width of 150 feet, increased at entrances and on curves, from Hilton Railway bridge to a point $2\frac{3}{4}$ miles above same, following in general the methods described in the report of the district officer and under the conditions of local cooperation recommended by the Board of Engineers for Rivers and Harbors, at an estimated cost of \$50,750 for first construction and \$3,000 annually for maintenance.

NEWBEGUN CREEK, N. C.—NEW PROJECT.

Abstract from the report of the Chief of Engineers, printed in Senate Document 24, Sixty-third Congress, first session:

This creek is a tributary of Pasquotank River, into which it empties from the west about 5 miles above the mouth of the river in Albemarle Sound. The mouth of the creek is obstructed by a bar on which the depth is about 4 feet. The district officer reports that back from the immediate banks the land is exceedingly

fertile, the principal produce being truck, which requires quick transportation to market and for which rail transportation is not sufficiently near at hand. To provide suitable facilities for navigation, the district officer submits a plan covering the dredging of a channel across the bar, via the southern route, having a depth of 5 feet at the mean stage and a bottom width of 40 feet, the cost of which is estimated at \$5,000. For reasons stated he expresses the opinion that this improvement is worthy of being undertaken by the United States, and in this view the division engineer concurs.

I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore, in carrying out the instructions of Congress, I report as follows: That the improvement by the United States of Newbegun Creek, N. C., is deemed advisable so far as to secure an available channel depth of 5 feet and a channel width of 40 feet, increased at entrances and on curves, following in general the methods described in the report of the district officer, at an estimated cost of \$5,000 for first construction and not exceeding \$1,000 every four years for maintenance.

Commerce, 5,000 tons annually, valued at \$300,000.

CAPE FEAR RIVER, N. C., AT AND BELOW WILMINGTON.

Location and description.—Cape Fear River is formed by the confluence at Haywood, N. C., in Chatham County, of the Deep and Haw Rivers. It flows in a southeasterly direction and empties into the Atlantic Ocean at Cape Fear, near the southern extremity of the State. Its total length is about 400 miles. The improvement of the river is divided into two parts—the section above Wilmington and the section at and below Wilmington. The stream is tidal and has a drainage area of about 350 square miles. This does not include the drainage area of Cape Fear River above Wilmington, 7,167 square miles, or of Northeast River, 1,600 square miles. The average discharge at ebb tide is about 160,000 cubic feet per second.

Existing project.—The existing project, which was adopted by the river and harbor act of July 25, 1912, provides for a channel having a uniform depth of 26 feet at mean low water, 300 feet wide in the river, and 400 feet wide on the ocean bar, at an estimated cost of \$572,940, and \$80,000 annually for maintenance, which includes the maintenance of New Inlet and Swash Defense Dams built under previous projects. (H. Doc. No. 287, 62d Cong., 2d sess., with map.) Average rise of tide is 4.5 feet at the ocean bar, 3.5 feet at Keg Island, and 2.5 feet at Wilmington. The length of the section of the improvement under this appropriation is about 30 miles.

Condition at the end of the fiscal year.—A channel of uniform depth of 26 feet at mean low water has been dredged, with a width of 280 to 400 feet on the ocean bar and 150 to 300 feet in the river channels to Wilmington. The present project is about 83 per cent completed. A 26-foot channel exists on the ocean bar from 280 to 400 feet wide. The anchorage basin at Wilmington has been dredged to 26 feet depth, and the channels at Lilliput, Old Brunswick Cove, and Midnight Shoals, and the lower reach of Snows Marsh Shoal redredged to project depth. A mean low-water depth of 26 feet exists from Wilmington to the ocean, excepting in the upper reach of Snows Marsh Channel, where it has shoaled to about 23 feet. Dams have been built across the mouth of the river, known as New Inlet, and across the breach from the river to the ocean between Smiths and Zekes Islands, these dams being known as the New Inlet Dam, completed in 1881, and the Swash Defense Dam, completed in

1888, respectively. New Inlet and Swash Defense Dams are in good condition. About 17 per cent of the present project remains to be completed, and consists entirely of dredging. For expenditures on present project up to June 30, 1916, for new work, \$460,976.42; for maintenance, \$435,000: total, \$895,976.42.

Effect of improvement.—Vessels coming to Wilmington are much larger than formerly, the average tonnage in 1886 being 421, while in 1915 the average was 1,462. The increase in tonnage has caused a corresponding decrease in freight rates.

Proposed operations.—The funds available for the fiscal year 1917 will be exhausted by about March 1, 1917. It is proposed to apply about \$80,000 of the amount to the maintenance of the dredged channels as provided for in the project and the balance to widening and deepening the present dredged channels to project width and depth. It is proposed to do the work by hired labor and Government plant, and the following estimate is submitted:

Operating and repairs:

Pipe-line dredge <i>Henry Bacon</i> , 8 months, at \$8,000-----	\$64,000.00
Seagoing dredge <i>Cape Fear</i> , 8 months, at \$4,000-----	32,000.00
Clamshell dredge <i>Hercules</i> , 5 months, at \$3,000-----	15,000.00
Borrowed seagoing dredge, 5 months, at \$5,000-----	25,000.00
Engineering and contingencies-----	16,524.36

Total -----	152,524.36
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It is proposed to apply \$80,000 of the \$115,000 estimated for the fiscal year 1917-18 to maintaining the ocean-bar channel and river channels up to Wilmington and the remaining \$35,000 to completing the project. It is proposed to expend about \$40,000 for dredging on the ocean bar, \$60,000 for dredging in the river channels, and about \$15,000 for engineering and contingencies.

It is proposed to do the work by hired labor and Government plant, and the following estimate is submitted:

Operating and repairs:

Pipe-line dredge <i>Henry Bacon</i> , 6 months, at \$8,000-----	\$48,000
Seagoing dredge <i>Cape Fear</i> , 10 months, at \$4,000-----	40,000
Clamshell dredge <i>Hercules</i> , 4 months, at \$3,000-----	12,000
Engineering and contingencies-----	15,000

Total-----	115,000
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Commercial statistics.—The commerce for the calendar year 1915 amounted to 709,570 short tons, valued at \$46,608,404.54, all of which passed over the improved sections of the stream. It consisted principally of cotton, cotton seed, cottonseed-oil cake, coal, fertilizer, fertilizer material, fish oil, general merchandise, lumber, and timber.

The foreign commerce, amounting to 150,148 tons of cotton, cottonseed-oil cake, fertilizer material, molasses, pig iron, and miscellaneous merchandise, valued at \$40,130,762, was carried by steamers drawing from 15 feet 7 inches to 22 feet and by schooners drawing from 12 to 15 feet. Coastwise commerce was carried as follows: 296,476 tons, valued at \$21,645,300.34, of bagging, cotton, general merchandise, lumber, etc., by steamers drawing from 14 to 20 feet; 16,574 tons, valued at \$117,110.50, of lumber, coal, cement, salt, etc., by schooners drawing from 12 to 20 feet; 44,013 tons, valued at \$1,161,769.30, of gasoline and kerosene, by barges drawing from 19 to 23 feet; 17,534 tons of phosphate rock, valued at \$87,670, by barges drawing 10 feet;

9,044 tons, valued at \$604,175.80, of general merchandise, farm produce, etc., by schooners drawing from 3 to 6 feet. The internal commerce and commerce passing over Wilmington Harbor—129,395 tons, valued at \$2,748,458.60, consisting of general merchandise, farm produce, naval stores, lumber, etc.—were carried by steamers, gasoline boats, and flats drawing from 2 to 6 feet; 46,386 tons of timber, valued at \$139,158, were rafted.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	773, 610	\$46, 736, 713. 06
1914.....	792, 304	28, 682, 163. 25
1915.....	709, 570	46, 608, 404. 54

The decrease in tonnage was on account of the small shipments of fertilizer material, due to the European war; the increase in value was on account of larger foreign cotton shipments and the establishment of a new steamer line between Wilmington and northern points.

Amount expended on all projects from Mar. 2, 1829, to June 30, 1916:

New work.....	\$5, 086, 591. 09
Maintenance	1, 037, 614. 25

Total	6, 124, 205. 34
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Balance available for fiscal year ending June 30, 1917.....	152, 524. 36
Amount (estimated) required to be appropriated for completion of existing project.....	35, 000. 00

Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement.....	35, 000. 00
For maintenance of improvement.....	80, 000. 00

Total	115, 000. 00
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WINYAH BAY, S. C.

Location and description.—Winyah Bay lies on the coast of South Carolina, 50 miles northeast of Charleston Harbor and 90 miles southwest of the entrance to Cape Fear River, N. C. Its breadth is small, being generally about 1½ miles, though at one place it attains a width of 4 miles. Its area is about 25 square miles, much of which is very shallow. This bay receives the waters of the Waccamaw, Great Peedee, and Sampit River systems. The city of Georgetown is located on the Sampit River, near the head of the bay, 13 miles in a northerly direction from the entrance bar.

Existing project.—Subsequent to the time covered by previous projects referred to in the preceding paragraph Congress authorized an enlargement of the channel in the Sampit River, opposite the city of Georgetown, and thence a new channel, to be secured by dredging and training walls, along the western shore of Winyah Bay in lieu of the 15-foot channel which traversed the central portion of the bay. Other features of previous projects were not changed. Ac-

cordingly the existing project in its entirety as adopted by the river and harbor act approved June 25, 1910, and including certain essential features of earlier improvements, provides for a channel 400 feet wide and 18 feet deep at mean low water from a point on the Sampit River 1 mile above the limits of the city of Georgetown to the entrance of Winyah Bay, following the western shore of the bay as far as may be necessary. (H. Doc. No. 398, 58th Cong., 2d sess., and Annual Report for 1904, p. 1591.) This channel is to be secured and maintained (a) by dredging in Sampit River opposite the city of Georgetown and across the bar at the mouth of the river in Winyah Bay; (b) by dredging in Winyah Bay, following the western shore for a distance of about 6 miles; (c) the construction of training walls at the head and foot of this dredged cut; (d) by dredging across the bar to the 18-foot curve at the entrance to the bay; (e) by the construction of two jetties springing, respectively, from North and South Islands and converging to give an opening 4,000 feet wide at the 18-foot curve on the seaward side of the bar; and, finally, (f) the construction of an earthen dike 14,300 feet long to protect the shore line of South Island at the southerly side of the bay. The tidal range on the bar entrance within the harbor is $3\frac{1}{2}$ feet. For map, see Annual Report for 1915, page 2394. The estimated cost for the existing project, exclusive of expenditures reported in foregoing paragraph on "Previous projects," was \$650,000. No estimate for maintenance was submitted.

Condition at the end of fiscal year.—Two jetties springing, respectively, from North and South Islands, at the mouth of the bay, were completed in 1903-4. These have an aggregate length of 32,190 feet, with a maximum crest height of 10 feet above mean low water, although portions at the outer ends are submerged at all times. Dikes of various forms have been built to protect the South Island beach and the shore end of the South Jetty. A seagoing suction dredge, the *Winyah Bay*, was completed in 1898. A channel 18 feet deep has been secured and fairly well maintained from a point on the Sampit River, 1 mile above the city of Georgetown, along the western shore of Winyah Bay to deep water at the mouth of the jetties. At the end of the year there was available in the western channel a 16-foot depth 400 feet wide, or a 17-foot depth with a least width of 200 feet. Shoaling has occurred in the four months during which the plant has been laid up, and to restore the channel to full depth and width will require the removal of about 244,000 cubic yards, place measurement. In the Sampit River there was available at the end of the year a channel 18 feet deep and 400 feet wide, except near the mouth, where the least width was about 175 feet. To secure full project dimensions will require the removal of 56,000 cubic yards. The dredging work on this project is about 97 per cent complete, exclusive of maintenance. No work has been done on the training walls contemplated by the project. The total expenditures under the existing project up to the end of the fiscal year were \$483,288.63 for new work and \$128,559.07 for maintenance, a total of \$611,847.70.

Effect of improvement.—This improvement has had the effect of allowing vessels using this port to carry larger cargoes by increasing their draft; vessels drawing 17 feet have used the channel at nearly low water, and the operation of ocean-going steamers and sailing vessels appear to secure Georgetown the usual port differentials which

are designed to meet water competition, this particularly on through freight from and to New York and Baltimore. The precise percentage of reduction of rates does not appear to be susceptible of determination.

Proposed operations.—It is proposed to maintain the western and jetty channels to their full width and depth, and to continue operations in Sampit River in the removal of rock to complete the channel included between the harbor lines to a depth of 18 feet. The work will consist of dredging with Government plant and hired labor. A special study of conditions will be made with a view to determining the location and dimensions of the training walls included in the project, and work will be begun.

The funds available June 30, 1916, augmented by \$100,000 carried by the river and harbor act of July 27, 1916, will be exhausted by June 30, 1917.

In the fiscal year ending June 30, 1918, the funds furnished under estimate below will be expended in maintenance of channel dimensions, utilizing Government plant and hired labor. Work will be continued on the training walls.

The amount that can profitably be expended in the fiscal year 1918 for new work and maintenance, is \$150,000.

Operations of dredge <i>Winyah Bay</i> (maintenance)-----	\$30, 000
Operations of dredge <i>Cheraw</i> (maintenance)-----	10, 000
Maintenance of plant-----	10, 000
Engineering and contingencies-----	15, 000
Construction of training walls-----	85, 000
Total -----	150, 000

Commercial statistics.—The principal articles of commerce during the current year were lumber, timber products, cotton, provisions, and general merchandise. There has been little change in the nature of the commerce during the past year. Outward freights increased in tonnage and value, due to increased activity in the lumber and cotton business. Freight rates on lumber and crossties advanced about 20 per cent during the year, a fact ascribed to conditions induced by the European war.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	211, 055	\$4, 849, 083
1914.....	175, 283	4, 146, 954
1915.....	183, 746	4, 900, 821

Amount expended on all projects from Aug. 2, 1882, to June 30, 1916:

New work-----	\$2, 881, 640. 51
Maintenance-----	252, 517. 71
Total -----	3, 134, 158. 22
Balance available for fiscal year ending June 30, 1917-----	107, 374. 23
Amount (estimated) required to be appropriated for completion of existing project-----	121, 559. 07

Amount that can be profitably expended in fiscal year ending
June 30, 1918:

For works of improvement-----	85,000.00
For maintenance of improvement-----	65,000.00

Total -----	150,000.00
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CHARLESTON HARBOR, S. C. (INCLUDING ASHLEY RIVER).

(A) CHARLESTON HARBOR.

Location and description.—This harbor is on the coast of South Carolina, about 15 miles southerly of the middle point of the coast line, 50 miles southwest of Winyah Bay, S. C., and 80 miles northeast of the mouth of the Savannah River. It is formed by a bay at the mouth of the Ashley and Cooper Rivers and is practically landlocked by outlying seacoast islands and portions of the mainland. The city of Charleston lies on a point of land between the Cooper and Ashley Rivers, $7\frac{1}{2}$ miles from the ocean bar. The total area of the harbor from the northern limits of the city to the gorge between Forts Sumter and Moultrie is about 6 square miles.

Existing project.—Subsequent to the completion of the work on previous projects Congress authorized the enlargement of the entrance channel by dredging to a width of 1,000 feet seaward of the jetties and to a depth of 28 feet throughout, as against the previous width and depth of 600 feet and 26 feet, respectively. Other features of previous projects were not changed, and accordingly the existing project in its entirety, as adopted by the river and harbor act of June 25, 1910, and including certain portions of previous projects, provides for establishing and maintaining, by means of two jetties and auxiliary dredging, an entrance channel of 28 feet deep at mean low water, 1,000 feet wide beyond the jetties, and 500 feet wide between them.

The jetties were completed in 1895, the height being 12 feet above low water for the greater part of their length. The north jetty is 15,443 feet long and the south jetty 19,104 feet; the width between the outer ends is 2,900 feet. The tidal range is 5.2 feet. The estimated cost for the existing project, exclusive of expenditures reported in the previous paragraph on "Previous projects," was \$371,616, with annual maintenance of about \$40,000. This estimate was subsequently increased by \$75,000, making the total estimate of cost as revised \$446,616. For map see page —.

Condition at the end of fiscal year.—The jetties protecting the ocean entrance channel through the bar had been completed prior to the adoption of the present project, and a channel 28 feet deep at mean low water, 800 feet wide beyond the jetties, and 500 feet wide between them had been secured by dredging. Twenty-eight feet draft can now be carried at mean low water from wharves on the Cooper River below Drum Island to the sea. The proportion of the approved project accomplished up to June 30, 1916, is about 95 per cent. The total expenditures under the existing project were \$390,887.38 for new work and \$26,483.89 for maintenance, a total of \$417,371.27.

Effect of improvement.—The improvement has slightly influenced the rates of marine insurance; otherwise it has had no effect on

freight rates. It has, however, greatly facilitated vessel movement, and the tendency is toward increased traffic, especially since the opening of the Panama Canal.

Proposed operations.—It is proposed to complete the project by dredging to the required width, the work to be carried on by hired labor, with Government plant, operating the U. S. dredge *Sumter* for about 12 months. It is expected that funds available June 30, 1916, augmented by \$70,000 carried in the river and harbor act of July 27, 1916, will be exhausted by July 1, 1917.

During the fiscal year 1918 it is proposed to maintain the channel to full depth and width, as specified in the existing project. Work will be dredging, and will be done with Government plant and hired labor, operating the U. S. seagoing hopper dredge *Sumter*.

The amount estimated as a profitable expenditure in the fiscal year ending June 30, 1918, is \$40,000, all for maintenance.

Operating U. S. dredge <i>Sumter</i> , 6 months.....	\$36, 000
Engineering contingencies.....	4, 000
Total.....	40, 000

Commercial statistics.—The principal articles of commerce during the current year were cotton, cotton goods, fertilizer materials, provisions, general merchandise, etc. Due to the European war the amount and value of commerce reported for the year was below normal, the import of fertilizer materials being nominal only. The value of cotton and cotton goods exported showed an increase of 44 per cent over that of the preceding year (1914), but was considerably below the average exported under ordinary peace conditions. Fertilizers and cotton are usually the two principal items in the business of the port. The export of coal was begun, but the growth of this business was hampered by the scarcity of bottoms.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	1, 043, 058	\$79, 225, 772
1914.....	919, 184	46, 800, 741
1915.....	920, 802	57, 394, 658

NOTE.—The figures for 1915 cover all freight received and dispatched at the port, and include 155,904 tons, valued at \$2,896,487, carried by small boats plying on inland waters between Charleston and near-by villages and plantations. In addition, 1,393,448 tons, valued at \$165,487,156, consigned to ports beyond, crossed the entrance bar in and out, bringing the grand total of all commerce using this harbor up to 2,314,250 tons, with a value of \$222,881,814.

Amount expended on all projects from Aug. 30, 1852, to June 30, 1916:

New work.....	\$5, 172, 650. 57
Maintenance	68, 427. 26
Total	5, 241, 077. 83

Balance available for fiscal year ending June 30, 1917.....	75, 917. 51
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	40, 000. 00

(B) ASHLEY RIVER, S. C.

Location and description.—This river rises near Summerville, S. C., and flows in a southeasterly direction about 40 miles through

Dorchester County, uniting with the Cooper River to form the harbor at Charleston, S. C. The stretch to the Standard Wharf, $7\frac{1}{4}$ miles above the confluence of the Ashley and Cooper Rivers, is the portion embraced in the project. It is virtually a portion of the Charleston Harbor. The river has a drainage area of about 320 square miles.

Existing project.—The existing project, which was adopted by the river and harbor act approved July 25, 1912, provides for a channel 20 feet deep at mean low water and 240 feet wide up to the Standard Wharf, about $7\frac{1}{4}$ miles, at an estimated cost of \$51,150. No estimate was submitted for maintenance. (R. and H. Com. Doc. No. 4, 62d Cong., 2d sess., without maps.) The tidal range is about 5 feet.

Condition at the end of fiscal year.—According to latest available survey there is a channel 20 feet deep and 240 feet wide from the mouth of the river up to the Standard Wharf, giving an increase of 14 feet over the original depth. This channel has been secured and maintained by dredging and will require redredging from time to time. Total expenditures under the existing project amounted to \$51,150 for new work, and \$14,475.28 for maintenance, a total of \$65,625.28.

Effect of improvement.—No effect on freight rates. The improvement has greatly facilitated vessel movement.

Proposed operations.—It is proposed to maintain the river in a navigable condition; the work will consist of dredging, and will be for maintenance. The necessary dredging will be done under contract. It is expected that funds available June 30, 1916, augmented by \$10,000 carried in the river and harbor act of July 27, 1916, will be exhausted by March 1, 1917.

For the fiscal year 1918 it is proposed to maintain the river by means of dredging, and all work will be done under contract.

The amount estimated as a profitable expenditure in the fiscal year ending June 30, 1918, is \$10,000 for maintenance.

Commercial statistics.—Included in statistics for Charleston Harbor, S. C.

Amount expended on all projects from June 14, 1880, to June 30, 1916:

New work	\$56, 650. 00
Maintenance	14, 475. 28
Total	<u>71, 125. 28</u>
Balance available for fiscal year ending June 30, 1917	10, 449. 40
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	10, 000. 00

CONSOLIDATED.

Amount expended on all projects from August 30, 1852, to June 30, 1916:

New work	\$5, 233, 450. 57
Maintenance	82, 902. 54
Total	<u>5, 316, 353. 11</u>
Balance available for fiscal year ending June 30, 1917	86, 366. 91
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	50, 000. 00

CHARLESTON HARBOR, S. C.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 288, Sixty-second Congress, second session:

Charleston Harbor is now being improved by the General Government under a project which provides for an entrance channel 28 feet deep at mean low water, 500 feet wide between the jetties and 1,000 feet wide beyond. Work thereunder is well advanced, the unappropriated balance necessary to complete being \$121,616. To deepen the channel to 30 feet at mean low water is estimated to cost an additional sum of \$140,000.

The officer temporarily in charge of this work, in report dated May 15, 1911, herewith, recommends that the existing project be first carried to completion and its effect noted before entering upon any larger project. He suggests, however, that in appropriating the remainder of the estimate for completing the 28-foot project, authority be granted to make the channel over the whole or any part of its authorized width as much greater than 28 feet as the amount available will allow, being of opinion that this will secure a 30-foot channel across the bar, though possibly of less width than contemplated in the existing project.

The Board of Engineers for Rivers and Harbors has visited the locality, made an inspection of the city and of the harbor throughout its length, and held a largely attended public hearing at which much information was presented orally and in writing. At this meeting local interests laid particular stress upon the advantages of Charleston Harbor as a harbor of refuge, and upon the need of the additional depth desired to meet the rapidly increasing draft of vessels. It was also developed at the hearing that steps have been taken toward providing improved terminal facilities which it appears will remove the handicap in this regard referred to by the district officer in his report on preliminary examination.

After carefully considering the subject, the board concludes that while the present and immediately prospective commerce is not sufficient in itself to warrant the increase in depth specified by the act, there is some need for additional depth for commercial purposes which, coupled with the advantages that would accrue to general shipping by having a safe and commodious harbor of refuge, is believed to be sufficient to warrant the additional expenditure of \$140,000 to secure a 30-foot depth. The board believes, however, that cooperation on the part of the locality by the provision of suitable terminal facilities should be assured.

I concur in general with the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore, in carrying out the instructions of Congress, I report as follows: That the further improvement by the United States of Charleston Harbor, S. C., is deemed advisable so far as to secure an available harbor depth of 30 feet, following in general the methods described in the report of the district officer, at an estimated cost of \$140,000 and \$40,000 annually for maintenance, subject to the condition that local authorities furnish evidence satisfactory to the Secretary of War that they will provide terminal facilities commensurate with the needs of the port.

GREAT PEEDEE RIVER, S. C.

Location and description.—This river is a continuation of the stream called the Yadkin River, which rises in the mountains in the northwestern part of North Carolina and flows in a general southeasterly direction into Winyah Bay. The total length of the stream from source to mouth exceeds 425 miles. The Peedee (or Great Peedee) is the name applied to that part of the river, about 234 miles, lying below the mouth of the Uwharrie River in North Carolina (near Moratock, Montgomery County). The portion of the river below Cheraw, 167 miles, is embraced in the project.

Existing project.—The existing project provides for a thoroughly cleared 9-foot navigation for 52 miles up to Smiths Mills and thence a 3½-foot navigation to Cheraw at all stages of water. This project originally contained no estimate of cost. In 1886 it was estimated that \$70,000 in addition to \$47,000 previously appropriated would

complete the improvement, and that \$5,000 a year would be required for maintenance.

Up to 1902 improvement had been confined to that part of the river below the bridge of the Atlantic Coast Line Railroad at Peedee, Marion County. The river and harbor act for that year required that improvement should begin on the upper river (the 64 miles between Cheraw and the bridge named) in conformity with the original project, at an ultimate cost not to exceed \$118,300. The report on which this was based contemplated \$4,000 for annual maintenance.

Condition at the end of fiscal year.—The work of improvement has consisted in snagging and dredging with Government plant and hired labor. The river was formerly cleared of snags from its mouth to the Atlantic Coast Line Railway bridge (103 miles). From that bridge to Cheraw (64 miles) a 3½-foot channel was secured. But as there has been no navigation in recent years on the upper river above Caines Landing, 86 miles from Winyah Bay, no improvement work has been done and that section of the river is now greatly obstructed. From Caines Landing to the mouth the river is in a fair condition, and 3-foot draft can be carried to that landing, while 9 feet can be carried to Smiths Mills, 52 miles from the mouth of the river. As the project is for snagging, work will be more or less continuous, and accordingly it is impracticable to state the percentage of completion. There has been no material change in the original depths. The total amount expended up to June 30, 1916, was \$183,712.41 for new work and \$151,966.62 for maintenance, a total of \$335,679.03.

Effect of improvement.—The improvement formerly enabled steamers to carry freights to points which could not be reached by rail. A railroad, recently built, connecting with the road to Georgetown and crossing the river at Allison's has caused a marked falling off in river business, although the rates are higher than the river rates.

Proposed operations.—It is proposed to maintain the river in a navigable condition up to Caines Landing, which is as far as the river is commercially used. Necessary snagging will be done with Government plant and hired labor, operating one snag boat for about four months. It is expected that the funds available June 30, 1916, augmented by \$5,000 carried by the river and harbor act of July 27, 1916, will be exhausted by March 1, 1917.

In the fiscal year 1918 it is proposed to maintain the channel to Caines Landing by operating one United States snag boat for about four months. The amount estimated as a profitable expenditure in the fiscal year ending June 30, 1918, is \$5,000.

Commercial statistics.—The general character of the commerce for the current year consisted of cotton, fertilizers, timber and its products, provisions, etc. There was little change in the nature of the commerce during the year and no change in freight rates. Tonnage and value both show a decrease due to improved railroad facilities.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	13,945	\$804,529
1914.....	17,461	587,673
1915.....	15,758	446,956

Amount expended on all projects from June 14, 1880, to June 30, 1916:

New work-----	\$183, 712. 41
Maintenance -----	151, 966. 62
Total-----	335, 679. 03
Balance available for fiscal year ending June 30, 1917 -----	5, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	5, 000. 00

CONGAREE RIVER, S. C.

Location and description.—This river is formed by the confluence of the Broad and Saluda Rivers, 1 mile above Columbia, S. C. It flows southeasterly about 52 miles till it unites with the Wateree River to form the Santee River. The stretch from Columbia to the mouth, a distance of 51 miles, is embraced in the project.

Existing project.—The existing project, which was adopted by the river and harbor act approved August 5, 1886, provides for a thoroughly cleared 4-foot navigation over the lower 49 miles at all stages, and a cleared channel 100 feet wide through the shoals above. (H. Ex. Doc. No. 254, 48th Cong., 2d sess., and Annual Report for 1885, p. 1140.) The cost was estimated at \$54,500. The river and harbor act approved March 3, 1899, authorized the construction of a lock and dam to extend deep water to Gervais Street Bridge, Columbia. (H. Doc. No. 66, 53d Cong., 2d sess., and Annual Report for 1896, p. 1183.) The cost was estimated at \$250,000. The river and harbor act approved June 25, 1910, provided for raising the dam 2 feet. (H. Doc. No. 608, 61st Cong., 2d sess.) The cost was estimated at \$56,000. Data concerning the lock and dam are as follows:

Location, 2 miles below Gervais Street, Columbia, S. C., 49 miles above mouth of river.

Lock dimensions:	Feet.
Length between miter sills -----	170
Clear width -----	55
Lift -----	10
Depth on miter sills at low water-----	6

Character of foundation, ledge granite.

Kind of dam, movable. Chanoine wickets.

Cost to date:	
Original structure -----	\$225, 000
Alterations-----	56, 000
Total-----	281, 000

The usual variation in water surface at a point 2 miles above the mouth is about 24 feet and at Columbia 33 feet. The plane of reference is ordinary low water. For outline map see Annual Report for 1889, page 1194.

Condition at the end of fiscal year.—A channel suitable for 4-foot navigation at all but extreme low-water stages has been secured by snagging and dredging. A lock and dam were completed in 1904, but the dam, having been destroyed by a flood in 1908, was rebuilt and raised 2 feet at the same time. Necessary alterations were also made in the lock. A 12-inch pipe-line dredge, the *Congaree*, has been built for dredging shoals in the river. The river is navigable to the foot of Senate Street, in Columbia, S. C. Expenditures have

not resulted in a permanent increase of depth below the dam, and dredging and snagging must be continued indefinitely in order to maintain the channel. The total expenditures on the existing, which is also the original, project were \$363,674.95 for new work and \$262,443.02 for maintenance, a total of \$626,117.97.

Effect of improvement.—No actual change in railroad freight rates has been made by the railroads themselves in order to meet competition. Complaints made by Columbia merchants of discrimination against Columbia in favor of Augusta have caused the Commerce Commission to order reduction in certain rates, thus giving Columbia the same advantage because of water transportation that had been given to Augusta, Ga., for the same reason. The low-water rate causes a much larger shipment than would otherwise come, since the rate enables Columbia to be a distributing point. The actual saving in freight rates on shipments made by all-water routes to Columbia from Boston, New York, and Baltimore averages from 24 to 27 per cent as compared with shipments made by water and rail between the same points.

Proposed operations.—It is proposed to maintain the river in a navigable condition by dredging and snagging channel as specified in the existing project. The necessary snagging and dredging will be done with Government plant and hired labor.

It is expected that funds available June 30, 1916, increased by allotment from the appropriation of \$55,000 carried by the river and harbor act of July 27, 1916, will not suffice for necessary work of maintenance to June 30, 1918, and an estimate for the additional sum of \$30,000 is submitted for this purpose.

Commercial statistics.—The principal articles of commerce during the current year were fertilizer, provisions, and miscellaneous general merchandise handled by a steamboat company running between Columbia and Georgetown. The value of the business has increased about 5 per cent during the year. There has been no change in the nature of the commerce.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	3,631	\$532,558
1914.....	6,077	624,955
1915.....	4,324	656,560

Amount expended on all projects from Aug. 5, 1886, to June 30, 1916:

New work.....	\$363,674.95
Maintenance.....	262,443.02

Total	626,117.97
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Balance available for fiscal year ending June 30, 1917.....	43,101.15
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	30,000.00
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CONGAREE RIVER, S. C.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 702, Sixty-third Congress, second session.

The Congaree River is formed by the junction of the Broad and Saluda Rivers, 1 mile above Columbia, S. C., and flows for a distance of about 52 miles, uniting with the Wateree to form the Santee River. The existing proj-

ect, adopted in 1886 and modified in 1899, provides for a thoroughly cleared 4-foot navigation at all stages over the lower 49 miles, and a lock and dam about 2 miles below Gervais Street, Columbia, to carry navigation over the rocky shoals to that point. The dam is now being raised, and when completed will provide a 6-foot pool to Columbia. A steamboat line has been in operation on the river for a number of years, and this line at present has its upper terminus at Granby, it being impracticable to reach Columbia until after completion of the work on the dam. On account of the presence of a number of shoals below Granby the operation of the steamboats has been attended with much delay and difficulty. While a persistent effort has been made to keep the channel open by the use of a 12-inch suction dredge, it appears that there are times when depths scarcely more than 2 feet are available in places. The survey discloses the fact that there are 10 shoals below the dam having depths less than 4 feet at low water.

It appears to the special board that, inasmuch as the dredging and the snagging have not been able to maintain the project, and that relying upon such a project a steamboat line has attempted to do business to Columbia and is continually enlarging its facilities, the Government should adopt more adequate means of improving the river. It outlines a plan involving bank protection and contraction works at an estimated cost of \$230,000, but believes that for the present this work should be confined to the shoals at Congaree and Gill Creeks, where improvement is urgently necessary and where it would produce the most beneficial results. The estimated cost of revetment and contraction work at these points is about \$100,000, with \$10,000 annually for maintenance. It believes, however, that the undertaking of this improvement by the United States should be contingent upon certain conditions of local cooperation.

Before starting the expensive work of bank protection, the Board of Engineers for Rivers and Harbors believes that it should be shown experimentally that it is impossible to maintain fairly satisfactory channel conditions by the use of a more powerful dredge, say, of 16 or 18 inch pump capacity. The sum of \$100,000 would be sufficient to provide such a dredge and operate it for a year, and the board recommends an appropriation of this amount for maintenance of a 4-foot navigable channel by dredging, assisted by regulation works, if necessary, subject to the following conditions proposed by the special board: That the expenditure of the appropriation herein recommended be made contingent upon a suitable connection being made between the Columbia Canal and the pool in the Congaree River above the lock and dam, whereby the river boats can be raised above the level of the river and placed on a general level with the city streets; and also upon the establishment along the line of this canal of suitable public terminals, open to all on equal terms and connected to the streets of the city by adequate public highways and to the existing railroads by spur tracks, all without cost to the United States, the plans for the canal connection and the location and construction of terminals to be subject to the approval of the Chief of Engineers and of the Secretary of War.

I am compelled to disagree with the views of the Board of Engineers for Rivers and Harbors and am disposed to accept those of the special board on the Congaree River. I have no doubt that a very large dredge, or a sufficient number of them, would maintain an adequate channel in the Congaree River throughout the period of low water, but, after careful, special study of the river, I am of the opinion that it is best to attempt to reduce the amount of material to be excavated by protecting the badly caving banks and thus reducing the supply of bar-making material. I believe also that public terminals at Columbia would be very desirable and think that the municipality should take advantage of the privilege that it now has to compel a junction to be made between the canal and the river whereby the former can be used as a landing place for boats. But, as the local interests have shown a willingness in the past to provide terminals, I do not think that it would be quite fair to render the moderate appropriation which it is proposed to recommend conditional upon the accomplishment of this rather expensive piece of canal work. I therefore report that the further improvement by the United States of the Congaree River, S. C., is deemed advisable to the extent of maintaining a 4-foot navigable channel by dredging, assisted by properly designed bank protection, and recommend that this protection be provided first at Congaree and Gill Creeks and that \$100,000 be provided in one appropriation for that purpose, together with \$10,000 annually for the operation of the dredge now owned by the work and for other necessary maintenance.

INLAND WATERWAY BETWEEN SAVANNAH, GA., AND BEAUFORT, S. C.

Location and description.—This waterway connects Savannah, Ga., and Beaufort, S. C., via Fields Cut, Mud River, and Ramshorn Creek. It has a length of 53 miles and a minimum width between banks of 200 feet. It consists entirely of tidal waterways which are practically unaffected by fresh-water flow.

Existing project.—The present project (see H. Doc. No. 295, 53d Cong., 3d sess., reprinted in Annual Report for 1895, p. 1520) was adopted as a part of the improvement of Savannah Harbor by the river and harbor act of June 3, 1896, and modified by the act of March 3, 1899. It provides for dredging a 7-foot channel at mean low water, width not specified, first by route No. 2 of document just mentioned, later modified to route No. 1 on account of exposed nature of this mouth and the partial closing of the Savannah entrance. This route, which has a length of 53 miles, follows Ramshorn Creek, Wright River, and Mud River. The mean tidal range is from 6.5 to 7 feet. The estimated cost of route No. 2 was \$106,700, and for the modification by route No. 1, \$84,700. The project does not specify a width of channel, but this width should be 100 feet in confined waters and 150 feet in open waterways. No estimate for maintenance was made, but there will probably be necessary for this purpose \$3,000 annually. There has been no map of this waterway published.

Condition at the end of fiscal year.—The project was completed July 20, 1900, and the project channel has been maintained since except at intervals when there were no funds available. There now exists a channel with a minimum low-water depth of 7 feet and a minimum width of 80 feet. There has been expended under the present project \$130,071.08, of which \$106,700 was for new work and \$23,371.08 was for maintenance.

Local cooperation.—There has been no local cooperation. There is a municipal wharf for the use of the public at Savannah 355 feet in length, built at a cost of \$9,556.

Effect of improvement.—This improvement has facilitated and rendered safer the water-borne commerce between Savannah and Beaufort, by providing an inland waterway, avoiding the exposed route via the mouth of the Savannah River and Calibogue Sound. The effect of the improvement on freight rates can not be stated.

Proposed operations.—It is proposed to expend the funds provided in the river and harbor act of July 27, 1916, as follows:

For operating, repair, and care of 1 pipe-line dredge 1 month-----	\$1, 500
For operating, repair, and care of 1 snag boat for 3 weeks-----	1, 000
Total -----	2, 500

The above amounts include proper reservations for office expenses, surveys, and contingencies.

The following estimate is submitted of funds needed for proposed operations from July 1, 1917, to June 30, 1918, including office expenses, surveys, and contingencies, care and repair of plant: For operating one pipe-line dredge and a snag boat two months at \$1,500 per month in maintaining the channel, \$3,000.

Commercial statistics.—The principal items of commerce during the calendar year 1915 were canned goods, 878 short tons, valued at

\$87,800; cotton seed, 1,047 short tons, valued at \$32,715; fertilizer, 6,214 short tons, valued at \$117,593; lumber, 6,316 short tons, valued at \$41,109; and oyster shell, 16,197 short tons, valued at \$41,279. The entire commerce of this waterway was carried on over the improved sections. The amount and value of the commerce for the last three years has been as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	166,641	\$1,680,635
1914.....	61,265	2,409,338
1915.....	62,496	2,712,693

Amount expended on all projects from June 3, 1896, to June 30, 1916:

New work.....	\$106,700.00
Maintenance.....	23,371.08
Total	130,071.08

Balance available for fiscal year ending June 30, 1917.....	2,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	3,000.00

SAVANNAH HARBOR, GA.

Location and description.—This harbor is 112 miles by water south of Charleston Harbor, S. C., and 111 miles by water north of Brunswick Harbor, Ga., and comprises the lower 20 miles of Savannah River, Tybee Knoll, Tybee Roads, and Tybee Bar, a total distance of 28 miles. The harbor has a length of 28 miles and varies in width from 600 to 1,800 feet.

Existing project.—The existing project provides for a channel 26 feet deep at mean low water, with widths varying from 400 to 600 feet, from the sea to the western limits of Savannah, a distance of 28 miles (H. Doc. No. 181, 59th Cong., 1st sess.); and for a channel 21 feet deep at mean low water and 300 feet wide from the latter point to the foot of Kings Island, a distance of 2 miles. (H. Doc. No. 563, 62d Cong., 2d sess.) The 26-foot channel was to be obtained by dredging, supplemented by the use of contraction works of brush and stone and of rubblestone. It was first estimated to cost \$2,705,699.48, with no estimate for maintenance. The project for this channel was tentatively adopted by the river and harbor act of March 2, 1907. It was definitely adopted by the river and harbor act of June 25, 1910, together with a revised estimate of \$1,545,000 (Annual Report for 1909, p. 336), exclusive of previous appropriations, amounting to \$1,000,000, to complete the project, and \$250,000 annually for maintenance. This amount was increased by \$100,000 under date of June 5, 1914, making a total of \$2,645,000 as the estimate for the 26-foot project. The project for the 21-foot channel was adopted by the river and harbor act of July 25, 1912. This channel was to be obtained by dredging alone, at an estimated cost of \$140,000, which was increased by \$220,000, under date of June 5, 1914, making the total estimate \$360,000. It was estimated that the

maintenance of the 21-foot channel would reduce correspondingly the necessary work of maintenance of the 26-foot channel so as not to increase the total cost of maintenance for the harbor.

The mean tidal range is 6.5 feet on the bar and 6.2 feet at Savannah. (For the latest published map see Annual Report for 1913, p. 2014.)

Condition at the end of fiscal year.—Since the commencement of the improvement work the channel covered by the 26-foot project has been materially straightened and deepened from 10 feet to 26 feet at mean low water by means of contraction work and dredging, mainly the latter, 137,370 feet of training wall having been constructed and 41,317,210 cubic yards of material having been removed from the channel by dredging. The controlling depth is 22 feet at mean low water. The 26-foot project was 85.9 per cent completed. On the 21-foot project 1,100 linear feet of channel have been improved so as to have the project dimensions. The 21-foot project was 50 per cent completed, the controlling depth being 14.5 feet at mean low water. The expenditures for the 26-foot channel have been \$1,772,949.46 for improvement and \$1,214,975.71 for maintenance, and for the 21-foot channel \$81,036.64, all of which was for original improvement, a total for both projects of \$1,854,486.10 for new work (including \$500 contributed funds) and \$1,214,975.71 for maintenance. To complete the 26-foot project there remains to be removed 2,365,000 cubic yards of material, and 600,600 cubic yards to complete the 21-foot project.

Local cooperation.—The owners of the ferry using Screvens Cut contributed \$500 for work in this vicinity under date of September 21, 1914. The city of Savannah has constructed a municipal wharf 355 feet in length, with loading slips, located in front of the main portion of the city, at a cost of \$9,556.

Under the 21-foot channel project the appropriation was made subject to the condition that before work was undertaken the city of Savannah should accept a certain parcel of land offered by interested parties and give satisfactory assurance to the Secretary of War that the city would provide suitable terminal facilities thereat. The Secretary of War accepted the assurances submitted by the city under date of October 15, 1912.

Effect of improvement.—The effect of the improvement has been a reduction in freight rates since 1896 of from 30 to 50 per cent, according to commodity. Commerce of the port has tripled in tonnage, with 10 times its original value.

Proposed operations.—It is proposed to expend the funds available on June 30, 1916, for the 26-foot channel in maintaining the channel by using one seagoing dredge and a 20-inch pipe-line dredge for six weeks at an estimated cost of \$22,378.92, including proper reservation for office expenses, surveys, contingencies, and care of plant.

It is proposed to expend the funds appropriated by the river and harbor act of July 27, 1916, after reserving \$45,000 for the engineer depot (\$350,000 will be expended), in maintaining and completing the 26-foot channel, using the two seagoing dredges, at an estimated cost of \$150,000; a 20-inch hydraulic dredge, at an estimated cost of \$100,000, for dredging; and expending \$100,000 for improvements by contract in raising existing training walls and dredging, reserving necessary funds for surveys, office, and miscellaneous expenses.

It is proposed to combine the present available funds for the 21-foot channel with the money appropriated by the river and harbor act of July 27, 1916, and to expend the total amount in continuing this improvement by dredging, either under contract or by Government plant, as appears most advantageous to the Government, proper reservation being made for contingencies, surveys, office expenses, and care of plant.

For the fiscal year ending June 30, 1918, the estimate for maintenance of 26-foot channel has been fixed at \$350,000, an increase of \$100,000 over the average for recent years. This is required on account of the increased shoaling occurring over the 28 miles of improved channel (see report of district officer) and the fact that the excavation will exceed by approximately 2,000,000 cubic yards the combined capacity of all plant on hand, the operation of which costs approximately \$250,000 annually.

It is proposed to expend the funds asked for as follows: Maintaining the 26-foot channel, using two seagoing dredges, at an estimated cost of \$150,000, and a 20-inch hydraulic dredge, at an estimated cost of \$100,000, for dredging, using Government plant and hired labor, and the expenditure of \$100,000 for dredging by contract or by the renting from some other district of another 20-inch hydraulic dredge, using hired labor. Proper reservation for necessary expenditures to cover office, surveying, and miscellaneous expenses will be made.

Commercial statistics.—The chief articles shipped during the calendar year 1915 were as follows: Cotton and linters, 430,704 short tons, valued at \$75,566,320; cottonseed meal and cake, \$221,386 short tons, valued at \$5,407,254; iron and steel, 138,259 short tons, valued at \$2,342,207; naval stores, 148,564 short tons, valued at \$7,258,322; and lumber, crossties, and lumber products, 383,104 short tons, valued at \$3,816,091. The principal receipts were canned goods, 15,357 short tons, valued at \$1,074,990; iron and steel, 62,368 short tons, valued at \$2,494,720; and salts, 48,175 short tons, valued at \$1,414,109. The Central of Georgia Railway Co. have constructed terminals costing about \$1,000,000, which are used by the Ocean Steamship Co. These terminals were completed June 3, 1916. The commerce for the last three calendar years has been as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	3,154,089	\$360,536,275
1914.....	2,478,535	349,193,325
1915.....	2,890,130	420,088,304

Amount expended on all projects from May 18, 1826, to June 30, 1916:

New work.....	\$9,114,870.08
Maintenance.....	1,513,869.97

Total.....	10,628,740.05
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Balance available for fiscal year ending June 30, 1917.....	576,342.28
Amount (estimated) required to be appropriated for completion of existing project.....	120,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	350,000.00

SAVANNAH HARBOR, GA., NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1471, Sixty-fourth Congress, second session:

The commerce of the harbor has steadily increased and now amounts to about 3,000,000 tons a year, valued at about \$350,000,000. Local interests are desirous of securing greater depth and width to meet the needs of ocean-going vessels, which are being constructed with increased size and draft. They also desire that the channel at West Broad Street be widened in lieu of the turning basin recommended in House Document No. 290, Sixty-third Congress, first session, and that mooring dolphins be provided at Five Fathom Hole, near Fort Oglethorpe, with some widening and deepening of the channel at that place. The district officer proposes to retain the present project depth of 26 feet at mean low water from the Seaboard Air Line Railway bridge at Savannah to Quarantine, giving this section a general width of 400 feet, and to increase the project depth to 30 feet from Quarantine to the sea, with a general width of 500 feet. He also considers advisable the repair of existing training walls and repair and extension of the jetties, the closing of the south channel, with a dredged cut between the river and Habersham Creek as an alternative, the widening of the channel at West Broad and Barnard Streets to 600 feet, and the widening of the channel opposite Fort Oglethorpe to 900 feet, with a provision of mooring dolphins, all at an estimated cost of \$1,920,000, including maintenance during construction and \$250,000 for an additional dredge, which is considered necessary for the prompt completion of the work and for its subsequent maintenance. The district officer, who is also the division engineer, expresses the opinion that the locality is worthy of further improvement to the extent indicated, provided that the widening at West Broad and Barnard Streets be contingent upon local interests furnishing free of cost any right of way found necessary, together with a convenient place for deposit of spoils.

I concur in the views of the district officer and the Board of Engineers for Rivers and Harbors and therefore report that the further improvement by the United States of Savannah Harbor, Ga., is deemed advisable to the extent proposed by the district officer, as described above, at a total estimated cost of \$1,920,000, including maintenance during construction, and \$350,000 per annum for maintenance of the entire project after completion; provided that the proposed widening at West Broad and Barnard Streets be contingent upon local interests furnishing free of cost any right of way found necessary, together with a convenient place for deposit of spoils.

DARIEN HARBOR, GA.

Location and description.—Darien Harbor is 32 miles by water north of Brunswick Harbor, Ga. It comprises the lower 12 miles of Darien River from the town of Darien, where the channel width is about 300 feet, to where the river enters Doboy Sound, where the channel width is about 1,000 feet.

Existing project.—The present project (H. Ex. Doc. No. 260, 48th Cong., 2d sess., and Annual Report for 1885, p. 1237) was adopted by the river and harbor act of September 19, 1890, and provides for the removal of the seven shoals between Darien and Doboy by dredging to secure a depth of 12 feet, and for the construction of wing dams at five of these shoals for maintaining the depth of the improved channel. The width of channel to be maintained was not specified, but it should be 150 feet. The tidal range is 7 feet at the bar and $6\frac{1}{2}$ feet at Darien. The estimated cost of the improvement was \$170,000. There is needed for annual maintenance \$2,000. No estimate for this was made in the project. No maps of this harbor have been published in congressional documents or in the annual reports.

Operations and results during the fiscal year.—There were no operations and no expenditures during the fiscal year, as no complaints were received as to the condition of the channel.

Condition at the end of fiscal year.—There was dredged from this harbor in 1879, 51,041 cubic yards of material at a cost of \$8,000, without any project having been recommended or adopted. Work under the present project commenced in 1891. Since then there has been removed from the various shoals 86,840 cubic yards of material. There were constructed 24 wing dams, aggregating in length 5,389 feet. The project was completed July 11, 1905. This work resulted in increasing the controlling depth from 6½ to 12 feet. Maintenance work has been necessary since, the present least usable depth being 10 feet at mean low water. There has been expended \$167,365.96, of which \$136,793.21 was for original work and \$29,072.75¹ for maintenance.

Effect of improvement.—This improvement has made it possible to ship lumber from Darien in schooners drawing from 15 to 17 feet. Formerly this lumber had to be rafted to Doboy Island. No reduction in freight rates can be definitely stated, though a reduction of about 15 per cent has been reported.

Proposed operations.—It is proposed to expend the funds appropriated by the river and harbor act of July 27, 1916, in restoring the channel to project dimensions by the operation of one hydraulic pipe-line dredge two months, at a cost of \$4,000, proper reservation being made for office expenses, surveys, and contingencies.

It is estimated that \$2,500 will be needed for maintenance of channel depths during the fiscal year ending June 30, 1918, to be used in operating one pipe-line dredge one month, including the care of plant, proper reservation being made for office expenses, surveys, and contingencies.

Commercial statistics.—The commerce consists almost entirely of lumber, the remainder being hardwood products and general merchandise. Lumber handled for the calendar year 1915 was 141,373 short tons, valued at \$1,114,921. For the last three calendar years the commerce has been as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	1 255,661	\$2,545,230
1914.....	1 204,465	2,167,415
1915.....	1 144,515	1,447,408

¹ Including lumber received at Darien in form of rafts from the Altamaha River.

Amount expended on all projects from 1879 to June 30, 1916:

New work	\$144,793.21
Maintenance	29,072.75

Total	173,865.96
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Balance available for fiscal year ending June 30, 1917.....	4,000.00
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	2,500.00
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¹ Amount reported in last Annual Report has been reduced \$1,500 because of reimbursable item previously included.

BRUNSWICK HARBOR, GA.

Location and description.—Brunswick Harbor is 71 miles, by sea, south of Savannah Harbor, Ga., and 24 miles, by sea, north of Fernandina Harbor, Fla. It embraces the improved channel across the bar, St. Simons Sound, Brunswick River, East River to the upper limits of the city, and Turtle River to the Southern Railway terminals; also that portion of Academy Creek used by shipping interests.

Existing project.—The present project (H. Doc. No. 407, 59th Cong., 1st sess.) was adopted by the river and harbor act of March 2, 1907. It provides for creating and maintaining throughout the inner harbor (embracing Turtle River from the Southern Railway terminals to its junction with Brunswick River, and Academy Creek and East River from Aikens Wharf to Brunswick River), and the outer harbor (embracing the outer bar, the navigable channel throughout the entrance to St. Simons Sound, and up Brunswick River to include Brunswick Point Crossing), channels having a depth of 30 feet at mean high water, with widths varying from 150 feet in Academy Creek to 400 feet across the outer bar, to be accomplished mainly by dredging; the extension of the training wall in East River and the construction of two spur dikes is also authorized. The estimated cost of the work was \$496,650, with a yearly cost of maintenance not exceeding \$33,250. The mean tidal range on the bar is 6.6 feet and at the city of Brunswick it is 7 feet. For the latest published map see House Document No. 393, Sixty-fourth Congress, first session.

Condition at the end of fiscal year.—The project was completed March 4, 1912, and the channel was being maintained. A training wall 4,250 feet long, carried to the level of mean high water, and connected with the shore at its upper end by a spur 335 feet long, had been constructed and was being maintained in lower East River. Throughout the harbor all shoals had been dredged to the project depth of 30 feet at mean high water and full project width. There has, however, been subsequent shoaling. At the end of the fiscal year the controlling depths and widths of channel at mean low water were as follows: Bar, depth 22 feet, width 300 feet; Brunswick Point, depth 23 feet, width 200 feet; East River, depth 20 feet, width 300 feet; Academy Creek, depth 19 feet, width 75 feet; lower Turtle River, depth 21.5 feet, width 300 feet; upper Turtle River, depth 22 feet, width 300 feet. There has been expended on the present project \$544,003.24 for new work, \$188,653.79 for maintenance, a total of \$732,657.03.

Local cooperation.—There has been no direct cooperation. The city of Brunswick has constructed a wharf costing about \$1,500, and a concrete landing which cost about \$1,000, both of which are open to use by all on equal terms.

Effect of improvement.—Before improvement in 1888 the annual commerce of Brunswick Harbor amounted to about 100,000 short tons, valued at \$1,700,000. The total amount of commerce for the calendar year 1913, the first year after completion of present project, amounted to 1,009,026 short tons, valued at \$58,258,725. The effect of the improvement has been to cause a reduction of ocean-going freight rates on lumber of 25 per cent and on naval stores of 30 per

cent. It has also permitted the regular line of coastwise steamers to enter and leave the port regardless of the stage of tide.

Proposed operations.—It is proposed to expend the available balance, \$7,759.62, as follows: According to former subproject, \$5,000 is to be reserved for the extension of East River training wall, and the balance will be expended for office expenses, surveys, and contingencies, probably exhausting this fund about September 1, 1916.

It is proposed to expend the funds appropriated by the river and harbor act of July 27, 1916, as follows: Reserving \$3,000 for the engineer depot at Savannah, Ga., and \$5,000 for the extension of East River Jetty, the balance will be expended in the operation of dredging, making use largely of seagoing dredges for about five months, with proper reservation for surveys, office expenses and contingencies, and care of plant.

It is estimated that the maintenance of the various channels will require the regular annual appropriation of \$33,250 for the fiscal year ending June 30, 1918, which it is proposed to expend as follows: \$5,000 will be reserved for extension of jetty in East River and the balance for the operation of seagoing dredges throughout the harbor for approximately five months, proper reservation being made for contingencies, surveys and office expenses, and care of plant.

Commercial statistics.—The principal articles of commerce for the calendar year 1915 were cotton, 53,614 short tons, valued at \$9,503,873; crossties, 126,151 short tons, valued at \$612,744; iron and steel, 22,635 short tons, valued at \$414,868; lumber and lumber products, 159,871 short tons, valued at \$1,523,913; naval stores, 44,082 short tons, valued at \$2,269,601. The amount and value of the commerce for the last three years has been as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	1,009,026	\$58,258,725
1914.....	487,224	38,343,320
1915.....	500,911	44,675,521

Amount expended on all projects from July 4, 1836, to June 30,

1916:

New work.....	\$1,187,468.42
Maintenance	243,067.86
Total	1,430,536.28

Balance available for fiscal year ending June 30, 1917.....	44,009.62
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	33,250.00

BRUNSWICK HARBOR, GA.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 393, Sixty-fourth Congress, first session:

As the mean tidal range is about 6.6 feet on the bar, 7 feet at Brunswick Point, and 7 feet at the city of Brunswick, the authorized channel depth is equivalent to a depth of about 23 feet at mean low water, which is not sufficient for the accommodation of the larger vessels visiting this port. Moreover, the

district officer points out that the vessels are generally more heavily laden when outbound than inbound, and as high tide occurs about one hour earlier at the outer bar than at Brunswick, which is 14 miles distant, they are not able to take full advantage of the tidal range. The commerce of this harbor has shown a steady increase since its improvement was undertaken by the United States, and in 1913 was reported as amounting to 1,009,007 tons, having a value of \$58,246,425. Considering all the circumstances set forth in the reports on preliminary examination and survey, the district officer is of opinion that this harbor is worthy of further improvement to the extent of providing channels as follows, all depths being referred to mean low water:

- (a) Bar Channel, 500 feet wide and 27 feet deep.
- (b) Brunswick Point Channel, 400 feet wide and 27 feet deep.
- (c) East River Channel, 350 feet wide and 24 feet deep.
- (d) Turtle River Channel, 350 feet wide and 24 feet deep.
- (e) Academy Creek Channel, 150 feet wide and 24 feet deep.
- (f) Cut from Academy Creek to Turtle River if later decided advisable.

The estimated cost of this work is \$561,000 for first construction and \$50,000 per annum thereafter for maintenance, both estimates being based on the assumption that Government dredges will be available for the work.

The board concurs in general with the recommendations of the district officer, but it believes that a depth of 24 feet in the Brunswick Point Channel will be sufficient for present and immediately prospective needs. As thus modified, the estimated cost of the project is \$510,000.

I concur in the views of the district officer and the Board of Engineers for Rivers and Harbors in regard to the need for increased navigation facilities at Brunswick Harbor, Ga., and therefore report that the further improvement of the locality is deemed advisable to the extent of providing channels 27 feet deep at mean low water across the outer bar and 24 feet deep at mean low water inside, in accordance with the project recommended by the board and described above.

Assuming that Government plant will be available for doing the work proposed, as now seems probable, the estimated cost of the project recommended is \$510,000 for first construction, \$156,500 for maintenance operations during the time the channels are being excavated, and \$50,000 annually thereafter for maintenance. The first appropriation should be \$240,000, with subsequent appropriations of sufficient amount to complete the work in about three years. If for any reason Government plant should not be available for doing the work, the estimated costs will be approximately twice those above given; but even under this supposition I am of the opinion that the project is a worthy one.

SAVANNAH RIVER BELOW AUGUSTA, GA.

Location and description.—The Savannah River is formed by the junction of the Tugaloo and Seneca Rivers on the northwestern part of the South Carolina-Georgia boundary line. It flows southeast on the boundary line and empties into the Atlantic Ocean 204 miles from its source, the distance by river being about 330 miles.

Existing project.—The existing project provides for a navigable steamboat channel 5 feet deep (the width not specified) at ordinary summer low water from Savannah, 17 miles from the mouth, to Augusta, a distance of 201 miles (H. Doc. No. 255, 51st Cong., 2d sess., which contains the latest published map), and was adopted by the river and harbor act of September 19, 1890. A modification as to the 20 or 25 miles immediately below Augusta (H. Doc. No. 962, 60th Cong., 1st sess.) was adopted by the river and harbor act of June 25, 1910. The project before modification provided for obtaining the necessary channel through the use of contraction work, the closure of cut-offs, and bank protection, and provided for the removal of snags, overhanging trees, and wrecks. The estimated cost of new work was \$331,884 and the cost of maintenance was esti-

mated at from \$3,000 to \$5,000 annually. The 1910 modification of the project has for its principal object the protection of the channel from the large amount of bar-forming material which is dropped into it at each freshet by the caving banks in the 20 or 25 miles immediately below Augusta. It provides for the construction of bank protection, training walls of pile, brush, and rock, the repair of similar existing structures, and the construction of a hydraulic dredge to be used in maintaining the channel. The estimated cost of this project was \$380,000 for new work. The annual cost of maintenance was estimated at \$10,000 until the completion of the new work, \$5,000 or \$6,000 thereafter. This, combined with the estimated cost of maintenance of the river below that affected by the modification, makes the total original estimated cost of maintenance approximately \$15,000. However, the annual cost of maintenance has been approximately \$30,000, and, owing to the increase in the needs of navigation of this river, it is deemed advisable to request this amount for maintenance work.

Condition at the end of fiscal year.—Snagging operations have been carried on since the improvement of the river was begun. In addition the channel depths have been increased on the worst bars by means of spur dikes, training walls, protection for caving banks, and dredging. There have been constructed and used in this work the snag boat *Tugaloo* and the 10-inch suction dredge *Augusta*, besides other miscellaneous plants. The project was completed in the fiscal year 1915. This work has resulted in maintaining a channel for steamboats drawing 5 feet when the river is at 7 feet on the Augusta gauge, which is the stage assumed as ordinary summer low water, upon which the project was based. With the river at 4 feet on this gauge, which is the low-water stage determined by the rule given in section 5 of the river and harbor act of March 4, 1915, the maximum draft which can be carried is only about 2 feet. The total expenditure under present project for new work has been \$645,566.56, and for maintenance \$220,367.80, a total of \$865,934.36.

Local cooperations.—There has been no direct cooperation. The city of Augusta is expending \$50,000 in rebuilding their municipal wharf and warehouse. The city of Savannah has constructed a municipal wharf 355 feet in length, with loading slips located in front of the main portion of the city, at a cost of \$9,556.

Effect of improvement.—The effect of the improvements in freight rates has been a reduction of from 30 to 50 per cent, according to the nature of the commodity, and also a relative control of freight rates between various points throughout the United States and the interior parts of Georgia.

Proposed operations.—It is proposed to use the available balance, \$3,421.60, in the care of the plant in use on this river at an average rate of \$500 per month, until such time in the fall as the river will require additional work, probably September 1, 1916, and to expend the balance remaining in the operation of one snag boat for approximately six weeks, making proper reservation for office expenses, surveys and contingencies, and care of plant.

The funds provided in the river and harbor act approved July 27, 1916, will be expended as follows, after reserving \$4,000 for the engi-

neer depot at Savannah, Ga., and proper amount for office expenses, surveys, and contingencies:

For operation, repair, and care of 1 pipe-line dredge 4 months, at \$1,500 per month, in removing bars	\$6,000
For operation, repair, and care of 1 snag boat 6 months, at \$1,500 per month, in removing snags, etc., and in miscellaneous work	9,000
For repair under contract or by day labor of 2,000 linear feet of bank protection and training walls, at \$5	10,000

The following estimate is submitted of funds needed for proposed operations from July 1, 1917, to June 30, 1918, for maintenance work, including proper reservation for office expenses, surveys, and contingencies:

For operation, repair, and care of 1 pipe-line dredge 6 months, at \$1,500 per month, in removing bars	\$9,000
For operation, repair, and care of 1 snag boat 6 months, at \$1,500 per month	9,000
For repair under contract or by day labor of 2,400 linear feet of bank protection and training walls, at \$5	12,000
Total	30,000

Commercial statistics.—The chief articles of commerce for the calendar year 1915 were cotton-factory products, 4,589 short tons, valued at \$1,147,250; cotton and linters, 2,159 short tons, valued at \$345,440; fertilizer, 2,391 short tons, valued at \$61,476; sugar 2,310 short tons, valued at \$258,720; and lumber, rafted, 25,563 short tons, valued at \$230,095. A new 225-ton twin-screw barge, propelled by producer-gas engine, was operated on the river from January 28 up to the end of the year. The amount and value of the total commerce for the last three years was as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	88,460	\$9,112,702
1914.....	72,821	3,508,123
1915.....	52,874	4,147,135

Amount expended on all projects from Mar. 3, 1881, to June 30.

1916:	
New work	\$739,046.65
Maintenance	220,367.80
Total	959,414.45
Balance available for fiscal year ending June 30, 1917	32,421.60
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	30,000.00

ALTAMAHA, OCONEE, AND OCMULGEE RIVERS, GA.

Location and description.—The Altamaha River is formed by the junction of the Oconee and Ocmulgee Rivers at a point known as The Forks, a little south of east of Savannah and 88 miles from it. The Altamaha flows to the southeastward and empties into the Atlantic Ocean by several mouths. Its entire length of 137 miles is under improvement.

The Oconee rises about 60 miles northeast of Atlanta, Ga., and flows to the southeastward to its junction with the Ocmulgee. It has a length of about 300 miles, of which the lower 145 miles and also an isolated stretch of 17 miles in Greene County are under improvement.

The Ocmulgee is formed by the junction of the Yellow and South Rivers, about 55 miles southeast of Atlanta, Ga., and flows in a southeasterly direction to where it joins the Oconee. Its length is about 350 miles, the lower 205 of which are under improvement.

Existing project.—The project now in force was adopted by the river and harbor act of July 25, 1912, and provides for an appropriation of \$40,000 per year, to be applied, following in general the methods which had been carried on under the previous project, to maintenance of 3-foot depth during ordinary summer low water up to Milledgeville and Macon and to the gradual increase on channel depth up to 4 feet so far as practicable without sacrificing the maintenance work. (H. Doc. No. 443, 62d Cong., 2d sess.) These methods are the removal of rock shoals, snags, logs, overhanging trees, and other obstructions; the closing of incipient cut-offs; the revetting of caving banks; and the use of spur dikes and training walls. The width of channel was not specified, but it should vary from 60 to 100 feet, according to locality. There are included under the project the entire Altamaha River with a length of 137 miles, the lower 145 miles of the Oconee, and the lower 205 miles of the Ocmulgee River, a total of 487 miles. For the latest published maps of the Altamaha River see House Document No. 283, Fifty-first Congress, second session; for those of the Oconee River see House Document No. 211, Fifty-first Congress, first session; and for those of the Ocmulgee River see House Document No. 215, Fifty-first Congress, first session.

Operations and results during the fiscal year.—All operations were carried on with Government plant and day labor. These, with their results, were as follows:

ALTAMAHA RIVER.

The rubble closing dam, 400 feet in length, commenced the preceding fiscal year at the cut-off known as Jacks Suck, was completed, 6,707 cubic yards of stone being used; also a drift catcher was constructed below the dam in the cut-off to fill it up. There was expended on this \$18,353.86, which was for maintenance. There was expended \$3,796.26 in dredging a channel 3,475 feet long, 100 feet wide, and 5 feet deep at ordinary summer low water, 33,287 cubic yards of sand having been removed.

OCONEE RIVER.

There was expended \$1,386.58 in dredging 5,677 cubic yards of sand from 605 feet of channel; \$4,670.50 in carrying on snagging operations on 101½ miles of river; and \$356.12 in quarrying rock which will be used in the closing dam at the cut-off at Bonny Clabber Landing.

OCMULGEE RIVER.

The new work consisted of improving six rock shoals by the removal of 4,706 cubic yards of rock and 7,997 cubic yards of clay from 3,605 linear feet of channel, so as to give a low-water depth of

4 feet for a width of 80 feet. A portion of the excavated rock was used in constructing training walls. There has been expended on this work \$8,073.34. The work of maintenance consisted in dredging 18,537 cubic yards of material from 2,320 linear feet of channel, at an expenditure of \$1,822.89, and carrying on snagging operations on 205 miles of channel, 60 miles of which were covered a second time, at an expenditure of \$2,085.77.

The expenditures during the fiscal year were \$49,972, of which \$41,899 was for maintenance.

Condition at the end of fiscal year.—Since the beginning of the improvement a navigable steamboat channel has been maintained by the removal of snags, stumps, logs, wrecks, overhanging trees, and other obstructions. Channel depths have been increased by the excavation of rock shoals, contraction works, bank protection, closure of incipient cut-offs, and dredging.

The project is of such a nature that the percentage of completion can not be stated. On June 30, 1915, the controlling depth on the Altamaha River at ordinary low water was 3 feet, on the Oconee to Dublin it was 3 feet, with 2 feet above, and on the Ocmulgee it was 2 feet from the forks to Hawkinsville and 2 feet from that point to Macon. These rivers are below the low-water stage considered about 5 per cent of the time. The expenditures on the present project to include June 30, 1916, have been \$152,959, of which \$109,966 was for maintenance.

Effect of improvement.—The effect of the improvement has been to enable navigation to be carried on safely at a stage 3 feet lower than was possible before any work was done and to increase the depth on shoals by about 2 feet. As nearly as can be determined, this has caused a reduction in freight rates at from 25 to 40 per cent.

Proposed operations.—It is proposed to expend the available balance, \$6,885.33, in snagging operations of approximately two months' duration and proper care of idle floating plant, with proper reservation for office expenses.

It is proposed to expend the funds appropriated in the river and harbor act approved July 27, 1916, as follows: \$3,000 will be reserved for the engineer depot at Savannah, Ga.; \$12,000 will be reserved for the construction or reconstruction of plant; and the balance will be expended in carrying forward the improvement by the removal of rock shoals and maintenance of the improvement by means of removal of snage, sand bars, and the repairs to training walls, including the ordinary care and repair of plant and necessary percentage for surveys, office expenses, and contingencies. This will entail the probable operation of the following plant:

Operation of snag boat <i>Oconee</i> 10 months	\$13, 500
Operation of snag boat No. 1, or similar plant, 10 months	5, 000
Operation of derrick boat <i>Sapelo</i> 12 months	14, 500
Operation of pipe-line dredge <i>Macon</i> 6 months	7, 000
Repairs to training walls and bank protection	5, 000
Total	45, 000

It is estimated that \$40,000 can be profitably expended during the fiscal year ending June 30, 1918, as follows (all amounts include contingencies, care, and repair of plant):

Operation of snag boat <i>Oconee</i> 10 months-----	\$13, 000
Operation of snag boat <i>No. 1</i> 8 months-----	4, 000
Operation of derrick boat <i>Sapelo</i> 12 months-----	14, 000
Operation of pipe-line dredge <i>Macon</i> 6 months-----	7, 000
Repairs to training walls and bank protection-----	2, 000
Total -----	40, 000

Constant snagging operations are necessary on these three rivers, as they are subject to frequent freshets and the banks are quite heavily wooded. It is proposed to use the derrick boat in removing rock shoals. The operation of the dredge is necessary to improve such sand shoals which will appear in the low-water season.

Commercial statistics.—The Altamaha: The principal articles of commerce were cotton, 673 short tons, valued at \$135,620; fertilizer, 1,686 short tons, valued at \$43,150; naval stores, 1,711 short tons, valued at \$79,502; and lumber, 67,993 short tons, valued at \$557,321. For the last three calendar years the commerce has been as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	111, 415	\$1, 682, 987
1914.....	103, 306	1, 896, 363
1915.....	76, 763	967, 205

The Oconee: The principal articles of commerce were cotton, 285 short tons, valued at \$60,370; fertilizer, 3,250 short tons, valued at \$80,500; oak blocks, 13,725 short tons, valued at \$63,450; staves, 1,462 short tons, valued at \$26,316; and lumber, 22,019 short tons, valued at \$207,100. For the last three calendar years the commerce has been as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	10, 440	\$574, 125
1914.....	38, 242	¹ 1, 509, 976
1915.....	41, 925	484, 091

¹ Marked difference in value of commerce for 1914 and 1915 is on account of classified freight having been reported as general merchandise in 1914 and an overestimate of the value of same.

The Ocmulgee: The principal articles of commerce during the calendar year 1915 were cotton, 845 short tons, valued at \$156,370; fertilizer, 3,400 short tons, valued at \$102,000; naval stores, 8,142 short tons, valued at \$286,977; and lumber, 13,759 short tons, valued at \$131,447. The Macon-Atlantic Navigation Co. operated their new self-propelled steel barge from Macon to the mouth of the river during the last five months of the year and anticipates putting on another new self-propelled barge about August, 1916. For the last three calendar years the commerce has been as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	28, 474	\$1, 388, 260
1914.....	28, 063	1, 484, 645
1915.....	33, 645	1, 127, 556

Amount expended on all projects from Aug. 14, 1876, to June 30, 1916:

New work-----	\$809, 398. 34
Maintenance -----	221, 917. 21
Total-----	<u>1, 031, 315. 55</u>
Balance available for fiscal year ending June 30, 1917-----	66, 885. 33
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement and for maintenance-----	40, 000. 00

FANCY BLUFF CREEK, GA.

Location and description.—This waterway is tidal and practically unaffected by fresh-water flow. It extends from South Brunswick River, at the mouth of Fancy Bluff Creek, $2\frac{1}{2}$ miles west of Brunswick, Ga., up Fancy Bluff Creek to near its headwaters, and thence by a cut 1,200 feet long to the Little Satilla River. It has a length of $4\frac{1}{2}$ miles.

Existing project.—The present project (H. Doc. No. 1342, 62d Cong., 3d sess., which contains the latest published map) was adopted by the river and harbor act of March 4, 1913. It provides for obtaining, by dredging, a 4-foot channel 50 feet wide at mean low water at an estimated cost of \$8,000. It was estimated that little or no maintenance would be necessary. However, about \$1,000 every three years will be needed for this purpose. The waterway has a length of $4\frac{1}{2}$ miles. The mean tidal range is 7.2 feet.

Condition at the end of fiscal year.—A dredged channel 4 feet deep at mean low water and 50 feet wide was finished January 31, 1914, completing the project. Subsequent sloughing and shoaling had reduced the dredged channel and necessitated the redredging of 4,350 linear feet of channel. The controlling depth at mean low water at the end of the fiscal year was 3.2 feet. There had been expended on the present project \$9,921.60, of which \$8,000 was for new work and \$1,921.60 was for maintenance.

Local cooperation.—Prior to the undertaking of this improvement on the part of the Federal Government Glynn County, Ga., as indicated above, had made a cut connecting Fancy Bluff Creek with Little Satilla River, the cost of which was about \$2,500. This cut was incorporated in the improvement.

Effect of improvement.—Passenger and freight traffic from Little Satilla to Brunswick had been made possible by the original cut and were materially facilitated by the deepening under the present project, which eliminates delays due to waiting on tides. It is believed that rates have been lowered to some extent, but the amount can not be stated.

Proposed operations.—No funds are available. Due to gradual deterioration, it is estimated that \$1,000 will be needed during the fiscal year ending June 30, 1918, for restoring project dimensions, to be used in operating a hydraulic dredge for three weeks.

Commercial statistics.—The principal articles of commerce for the calendar year 1915 were naval stores, 292 short tons, valued at \$15,977, and lumber and crossties, 1,185 short tons, valued at \$5,250. The amount and value of the commerce for the last three years has been as follows:

Comparative statement.

Calendar year.	Short tons.	Value.	Passengers.
1913.....	3,840	\$86,000	22,400
1914.....	3,606	150,692	8,000
1915.....	2,513	84,882	10,228

Amount expended on all projects from Mar. 4, 1913, to June 30, 1916:

New work.....	\$8,000.00
Maintenance.....	1,921.60
Total.....	9,921.60

Amount that can be profitably expended in fiscal year ending June

30, 1918. for maintenance of improvement.....	1,000.00
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SATILLA RIVER, GA.

Location and description.—This river has its headwaters in southern and southeastern Georgia, flows in a generally southeasterly direction, and empties into the Atlantic Ocean through St. Andrews Sound; its length is about 350 miles, of which the lower 67 miles is tidal.

Existing project.—The present project for the improvement from the mouth to Burnt Fort, a distance of 52 miles, was adopted by the river and harbor act of July 25, 1912, and provides for the removal of snags and similar obstructions. It was estimated that the original work would cost \$6,000, and that \$4,000 would provide maintenance for a few years. (H. Doc. No. 41, 62d Cong., 1st sess.) The latest map of this portion of the river is published as United States Coast and Geodetic Survey Chart No. 450. The mean tidal range is 6.9 feet at the mouth and 3.4 feet at Burnt Fort.

The project for the improvement from Burnt Fort up to Waycross was adopted by the river and harbor act of March 4, 1913, and provides for the removal of obstructions and the closing of incipient cut-offs, at a cost of \$10,000, and the appropriation of such amounts as should be necessary for maintenance for a few years, until the advisability of continuing the project should be determined. This portion of the river has a length of 114 miles. (H. Doc. No. 1113, 62d Cong., 3d sess., with map.)

The amount needed annually for maintenance can not be estimated until longer experience has been had.

Conditions at the end of fiscal year.—The controlling depth to Owens Ferry, 30 miles from the mouth, is from 11 to 13 feet at mean low water; to Burnt Fort, 52 miles above the mouth, it is 6 feet at ordinary summer low water; for 100 miles above Burnt Fort it is about 3 feet; and to Waycross, the upper limit of the improvement, 166 miles above the mouth, it is about 1 foot. It is thought that the river will be below the "ordinary summer low water" on an average of 18 days per year. The river has been cleared of all the most troublesome obstructions. The project for the lower 52 miles was completed March 4, 1913. The entire project was completed November 27, 1914, for \$6,548.41 less than the estimated cost. There had

been expended on the present project \$9,970.98, of which \$9,451.59 was for new work, and \$519.39 was for maintenance.

Effect of improvement.—The effect of the improvement on freight rates can not be stated; it has, however, extended steamboat navigation to the Atlantic Coast Line Bridge, 93 miles above the mouth and 37 miles above the upper limit of steamboat navigation before the improvement. The improvement has also made possible the rafting of timber at almost all stages of the river.

Proposed operation.—It is proposed to expend the available funds, \$1,621, working over as much of the lower portion of this river as is practicable with the funds at hand, removing snags, obstructions, etc., with the proper reservation for office expenses, surveys, and contingencies and care of plant.

It is estimated that during the fiscal year ending June 30, 1918, \$2,000 will be needed for the operation of one snag boat one month in clearing the lower 93 miles of river of snags, etc., with proper reservation for office expenses, surveys, and contingencies and the care of plant.

Commercial statistics.—The chief articles of commerce were cross-ties, 4,103 short tons, valued at \$16,598; lumber, 59,612 short tons, valued at \$296,625; and naval stores, 1,301 short tons, valued at \$65,683. The amount and value of the commerce for the last three years has been as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	121,098	\$1,724,712
1914.....	61,997	797,013
1915.....	67,398	723,447

Amount expended on all projects from July 25, 1912, to June 30, 1916:

New work.....	\$9,451.59
Maintenance	519.39
Total	<u>9,970.98</u>

July 1, 1916, balance available..... 1,621.00

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 2,000.00

WATERWAY BETWEEN SAVANNAH, GA., AND FERNANDINA, FLA.

Location and description.—This waterway is tidal throughout. It connects Savannah, Ga., and Fernandina, Fla., via Skidaway Narrows, Creighton Narrows, Little Mud River, Frederica Creek, Jekyl Creek, and Cumberland River, a distance of 147 miles.

Existing project.—The existing project (H. Doc. No. 1236, 60th Cong., 2d sess., containing the latest published map) was adopted by the river and harbor act of June 25, 1912. It provides for obtaining a channel 7 feet deep at mean low water and 150 feet wide by means of dredging, possibly supplemented by the construction of training walls, over the main inside route, including the following special localities, most of which have been partially improved under

former projects, namely: Skidaway Narrows, Creighton Narrows, Little Mud River, and Jekyl Creek, these localities being the only ones where alternate routes have been prescribed. Auxiliary channels were also authorized, as follows: A 7-foot channel at mean low water through Three Mile Cut, near Darien, protected channels around St. Simons and St. Andrews Sounds with a mean low-water depth of 3 feet, an 8-foot channel at mean low water to the southern end of Cumberland Island, and the 7-foot channel at Club and Plantation Creeks, which was under construction as a separate work. This waterway, including the supplementary routes, has a length of 183 miles. The mean tidal range is about 7 feet over the greater part of the route, the minimum range being 6.2 feet and the maximum 8 feet. The estimated cost of the improvement was \$237,700. This includes the amount necessary to complete the Club and Plantation Creeks improvement, viz, \$20,700, which amount was appropriated in the river and harbor act of June 25, 1910. The estimates should, therefore, be reduced to \$217,000. This included an estimate of \$75,000 for partial cost of a dredge to be used on this route and upon the Savannah River below Augusta, Ga., but due to the delay in adopting the project the necessary plant for the Savannah River had already been acquired.

Condition at the end of fiscal year.—By dredging, supplemented by the construction of training walls and closure dams at a few localities, the full project depth of 7 feet at mean low water had been obtained over the entire main route at one time or another. This included cuts at Skidaway Narrows and Creighton Narrows, which were not formerly portions of the route. The dredged channels had generally been of less than the project width of 150 feet. Alternate routes at Three Mile Cut and around St. Andrews Sound have been dredged. The 12-inch pipe-line dredge *Creighton*, with the necessary auxiliary plant, was constructed for this waterway and completed May 31, 1915, at a cost of \$62,470.18. At the end of the fiscal year the localities with less than the controlling depth of 7 feet at mean low water were as follows: Florida Passage, with 6 feet; Big Mud River, with 5 feet; Creighton Narrows, with 4 feet; South Sapelo Dividings, with 6 feet; and Little Mud River, with 6.5 feet. There had been expended on the present project \$133,762.84, of which \$103,641.81 was for new work and \$30,121.03 was for maintenance.

Local cooperation.—In 1883 the Georgia & Florida Steamboat Co. contributed \$5,000 toward making the cut through Romerly Marsh. In 1885, with the approval of the Secretary of War, private parties deposited \$22,108.77, which was used in continuing and completing this improvement, the appropriations for the work having been exhausted. These parties were afterwards reimbursed. The rights of way for all cuts through marshland have been furnished free of cost to the United States.

Effect of improvement.—The improvement had greatly facilitated the movement of coastwise commerce in vessels of moderate size. It is impossible to state what has been its effect on freight rates.

Proposed operations.—It is proposed to expend the available funds in the continuation of the improvement by dredging, and the amount, \$4,352.41, after proper reservation for contingencies, care of plant, etc., will operate one hydraulic pipe-line dredge for a month and a half.

It is proposed to expend the funds appropriated in the river and harbor act approved July 27, 1916, in continuing the improvement and maintenance work, including office expenses, surveys, contingencies, and care and repair of plant, as follows:

For operation of one hydraulic pipe-line dredge, including care of plant, 12 months	\$35, 000
For engineer depot at Savannah, Ga	5, 000
Total	40, 000

The operation of one pipe-line dredge will be necessary to take care of the shoaling which regularly takes place in the dredged channels and to continue the work of completing the improvement.

It is estimated that during the fiscal year ending June 30, 1918, \$40,000 can be expended for continuing the project and maintenance work, as follows, including necessary office expenses, surveys, and contingencies, care and repair of plant:

Operation of one 12-inch pipe-line dredge, 10 months	\$33, 000
Operation of one 10-inch pipe-line dredge, 4 months	7, 000
Total	40, 000

Commercial statistics.—The principal articles of commerce during the calendar year 1915 were crossties, 11,458 short tons, valued at \$53,463; fish and oysters, 6,781 short tons, valued at \$82,679; lumber, 92,274 short tons, valued at \$669,468; oyster shells, 28,247 short tons, valued at \$52,027; and naval stores, 2,675 short tons, valued at \$135,361. The amount and value of the commerce for the last three years has been as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	¹ 204, 142	\$4, 586, 695
1914.....	¹ 157, 771	4, 042, 181
1915.....	¹ 157, 932	3, 000, 627

¹ Including all lumber.

Amount expended on all projects from Aug. 2, 1882, to June 30, 1916:	
New work	\$298, 138. 77
Maintenance	164, 897. 24
Total	463, 036. 01
Balance available for fiscal year ending June 30, 1917	44, 352. 41
Amount (estimated) required to be appropriated for completion of existing project	113, 358. 19
Amount that can be profitably expended in fiscal year ending June 30, 1918:	
For works of improvement	20, 000. 00
For maintenance of improvement	20, 000. 00
	40, 000. 00

ST. MARYS RIVER, GA. AND FLA.

Location and description.—This river has its source in the Okefenokee Swamp, and flows, first, in a southeasterly direction, and

thence due north, thence in a southeasterly direction, and empties into Cumberland Sound, about 3 miles north of Fernandina, Fla. It has a length of about 180 miles, the lower 80 miles being tidal.

Existing project.—The present project (H. Doc. No. 697, 62d Cong., 2d sess., containing the latest published map) was adopted by the river and harbor act of July 25, 1912. It provides for securing, by dredging, a channel 17 feet deep at mean low water, and with a width of 200 feet from the mouth to Crandall, 12.5 miles, at an estimated cost of \$14,450; and to clear the channel of snags to Kings Ferry, 37 miles above the mouth, and as much farther as may be practicable with the sum of \$5,000, or a total estimated cost of \$19,450. The cost of maintenance was to be determined by experience. This so far indicates that there will be needed for this purpose about \$5,000 every two years. The mean tidal range is as follows: At the mouth, 5.9 feet and at the Atlantic Coast Line bridge, 55 miles above the mouth, 1.4 feet.

Condition at the end of fiscal year.—The dredging necessary to secure a channel 17 feet deep at low water and 200 feet wide was completed June 13, 1913. The river was cleared of snags in the lower 53 miles in May and June, 1913. Snagging operations were carried on over the 6 miles below Traders Hill, which is 59 miles above the mouth, in December, 1914. The entire project was completed in December, 1914, for \$3,761.64 less than the estimated cost. The controlling depth at the end of the fiscal year on the lower 12½ miles was 17 feet. The river was very free of snags except the extreme upper portion, which was fairly free of them. There had been expended on the present project \$21,670.98, of which \$15,688.36 was for new work and \$5,982.62 was for maintenance.

Local cooperation.—None. The city of St. Marys has a municipal wharf with a frontage of 50 feet.

Effect of improvement.—The improvement has made it possible for seagoing vessels to complete their cargoes in the river. Formerly vessels after taking on a part of their cargo proceeded to Fernandina or Cumberland Sound, where the remainder of the cargo had to be lightered to complete the loading. The effect of the improvement on freight rates can not be stated.

Proposed operations.—The available funds will be expended for care of plant and office expenses, at an average monthly rate of \$60, exhausting same by March 1, 1917.

It is estimated that for the fiscal year ending June 30, 1918, \$7,000 will be needed for maintenance, to be expended as follows: Operation of one pipe-line dredge on lower portion, two months, at \$3,000, and one snag boat one month on upper portion, at \$1,000, including contingencies; a total of \$7,000.

Recommended modifications of project.—An extension of the project is recommended which includes increased depth for the channel to the west boundary of St. Marys, Ga., at an estimated cost of \$31,500 for first construction and \$5,000 annually for maintenance. (See H. Doc. No. 540, 64th Cong., 1st sess.)

Commercial statistics.—The principal articles of commerce during the year were crossties, 9,151 short tons, valued at \$37,918; naval stores, 1,612 short tons, valued at \$84,313; lumber, 86,842 short tons,

valued at \$549,453. The amount and value of the commerce for the last three years has been as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	53,400	\$1,627,344
1914.....	74,038	931,891
1915.....	100,894	1,139,717

Amount expended on all projects from July 25, 1912, to June 30, 1916:

New work.....	\$15,688.36
Maintenance.....	5,982.62

Total.....	21,670.98
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July 1, 1916, balance available.....	482.06
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	7,000.00
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ST. MARYS RIVER, GA. AND FLA.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 540, Sixty-fourth Congress, first session.

The present investigation pertains only to that part of the river between St. Marys and the mouth, a distance of 5 miles, in which the mean tidal range is 5.8 to 5.9 feet. At a cost of approximately \$3,500,000, the United States has improved the entrance to Cumberland Sound, which now affords a depth over the bar of 24 feet at low water. This entrance must be used by all ocean vessels bound either for Fernandina or St. Marys. The principal articles of commerce on St. Marys River are lumber, timber, crossties, and naval stores, amounting to about 53,000 tons, of which about 44,000 tons pertain to the reach under consideration. Some of this commerce is carried on light-draft boats and barges, and some on vessels drawing up to 20 feet. Deep-draft vessels are obliged to lighter part of their cargoes, and the improvement desired is a channel which will render such lighterage unnecessary.

The district officer, who is also the division engineer, submits estimates of cost of a channel 22 feet deep and 300 feet wide, amounting to \$118,780.20, and of the same depth and 200 feet wide, amounting to \$66,080.52, the annual maintenance in either case being estimated at \$12,000. In his supplemental report of October 19, 1915, he submits an estimate for a channel 20 feet deep at mean low water and 200 feet wide, in the sum of \$31,500, and \$5,000 annually for maintenance. He expresses the opinion that it is not advisable for the United States to undertake the provision of the deeper channel, as specified in the act, on account of the large cost of original work and subsequent maintenance, but that it is advisable to provide the smaller channel, at the cost indicated.

I concur in the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of St. Marys River, Ga. and Fla., is deemed advisable to the extent of providing a channel 20 feet deep at mean low water and 200 feet wide, from deep water at its junction with Cumberland Sound, up to the city of St. Marys, at an estimated cost of \$31,500 for first construction, and \$5,000 annually for maintenance.

HARBOR AT MIAMI (BISCAYNE BAY), FLA.

Location and description.—Biscayne Bay is a large, shallow, salt-water sound lying between the Florida Keys and the mainland on the east coast of Florida, near the southern extremity of the peninsula. The city of Miami is situated on the west side of the bay, about midway between its head and its principal entrance at Cape Florida.

Miami is about 335 miles south of the mouth of the St. Johns River and 160 miles north and east of Key West. The harbor embraces the artificial basins and channels that have been dredged along the city front and through the shoal waters of the bay to the ocean.

Existing project.—The existing project, which is a modification and extension of the former project, was adopted by the river and harbor act of July 25, 1912. (H. Doc. No. 554, 62d Cong., 2d sess.) The conditions of local cooperation were modified by the river and harbor act of March 4, 1913. The project provides for an entrance channel 300 feet wide and 20 feet deep at mean low water from the ocean to the bay, through the cut made under the previous project, with a refuge basin 18 feet deep in the bay near the inner end of this cut, and the probable extension of the jetties about 500 feet. The plan of improvement embraces dredging and rock excavation in the channel, with a land cut through the peninsula and two parallel stone jetties, built under the earlier project, with extensions, if necessary, for the protection of the entrance. The estimated cost of the new work contemplated was \$400,000. The mean tidal variation is 2.2 feet at the entrance and 1.5 feet in the bay. For latest published map of the locality, see House Document No. 554, Sixty-second Congress, second session.

Condition at the end of fiscal year.—Under the first project and its modifications, two stone jetties were built at the entrance, the shore at the inner ends of the jetties was protected by a shore revetment, and a channel was dredged through the rock and sand 18 to 20 feet deep and 110 feet wide for 2,410 feet, and 85 feet wide for the remainder of its length. This channel, however, rapidly shoaled, and the result of the work was a usable depth not greater than 7 or 8 feet. The jetties were completed to the 18-foot contour in the fiscal year 1909 and the shore protection in the fiscal year 1912. No actual improvement work has been done under the existing project. The controlling depth is about 7 feet at mean low water. The cut is not used by vessels, except small launches and fishing boats, others using the old entrance at Cape Florida. The total expenditure under the existing project to June 30, 1916, has been \$1,397.24, all of which is chargeable to new work.

Local cooperation.—The river and harbor act of June 13, 1902, adopting the first project, imposed the condition that the Florida East Coast Railway Co. should construct at its own expense a basin 1,600 feet long and 500 feet wide adjacent to the wharves at Miami, and a channel not less than 85 feet nor more than 100 feet wide across the bay from this basin to the basin to be dug by the United States near the entrance, and should contract with the United States to secure in the basin and channel depths equal to that obtained by the United States in the entrance, and to maintain these depths for three years after completion of the entrance channel. It was also required that the channel and basin should be open to the free and unobstructed use of the public, and that the railroad wharves and other facilities should be open to use by all shippers at reasonable rates and on just and reasonable conditions.

A contract containing the required stipulations was entered into on October 15, 1902, between the Secretary of War, on behalf of the United States, and the Florida East Coast Railway Co. Between March, 1903, and January, 1906, the railway company dredged the

channel across the bay to a width of 100 to 120 feet and to a least depth of 12 to 14 feet at mean low water, and constructed a basin in front of its wharves at Miami 1,000 feet long and 500 feet wide, with an available depth of 10 feet or over. The amount expended by the railway company in this work was over \$200,000.

The river and harbor act of July 25, 1912, adopting the present project, as amended by the river and harbor act of March 4, 1913, imposes the condition that local interests shall provide suitable terminals, open to public use, and provides that nothing in the act shall be construed to relieve the railroad company of its obligations under its contract with the United States.

The railway company declined to do any further work in the channel across the bay, and suit to enforce specific performance of the contract was instituted. The case was tried in July, 1914, and was decided adversely to the United States.

On April 26, 1915, the Secretary of War approved terminal plans adopted by the city of Miami, and on January 18, 1916, the Secretary of War accepted the evidence submitted by the city as satisfactory assurance that suitable terminals will be provided as required by the appropriation act. The plans contemplate the construction of wharves on the bay front, the excavation of a turning basin in front of them, and the dredging of a channel 100 feet wide and 18 feet deep at low water from the turning basin across the bay to the inner end of the Government cut. Work on both the wharf construction and the dredging of the channel is well advanced, and the completion of the city's part of the work by December 1, 1916, is anticipated. The cost will be about \$575,000, the funds being raised by special issues of city bonds.

Before the improvement of Biscayne Bay was undertaken by the United States the Florida East Coast Railway Co. and the Peninsula & Occidental Steamship Co. dredged at their own expense a channel 9 feet deep from the Cape Florida entrance to the railway wharves in the Miami River. Later, this channel was made 12 feet deep at the entrance and up the bay to the new railway wharves on the bay front. This channel has been redredged from time to time, and is the channel now used by vessels. The cost of the work was over \$150,000.

Effect of improvement.—The project in its incomplete state has had no effect on freight rates and has afforded no direct benefit to commerce.

Proposed operations.—Available funds will be applied to dredging the entrance channel to project dimensions, doing the work by contract if reasonable prices can be secured, otherwise with United States plant. It is expected that this work will be completed by December 1, 1917.

With funds asked for in the estimate for 1918 it is proposed to repair the shore revetment, extend the jetties, and dredge for maintenance as required. The following detailed application of funds is proposed:

For extending the jetties by contract.....	\$110, 000
For repairing shore revetment.....	10, 000
For superintendence, office expenses, and contingencies.....	15, 000
For operating United States dredge, for maintenance, 3 months at \$8.333	25, 000
Total.....	160, 000

Commercial statistics.—The water commerce for the calendar year 1915 consisted of brick, canned goods, cement, fish, grain and hay, hardware, machinery, oranges and grapefruit, oils and gasoline, rock, sand, and vegetables. The tonnage for the year amounted to 388,812 short tons, valued at \$4,746,689, an increase in tonnage over the preceding year of 217.4 per cent. The increase is in two items, sand and stone, for building purposes. The commerce is handled by steamers and schooners drawing 8 to 11 feet, by fishing boats drawing 4 to 5 feet, and the sand and shell in barges. Little or none of this commerce used the channel under improvement by the United States.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	123,850	\$2,946,808
1914.....	122,789	3,197,136
1915.....	388,812	4,746,689

Amount expended on all projects from June 13, 1902, to June 30.

1916:	
New work.....	\$554,846.02
Maintenance	11,953.33
Total	566,799.35
Balance available for fiscal year ending June 30, 1917.....	237,203.12
Amount (estimated) required to be appropriated for completion of existing project.....	160,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement.....	160,000.00

BOCA CEIGA BAY, FLA.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 135, Sixty-third Congress, first session:

Boca Ceiga Bay is a tidal sound lying between the western coast of Florida and the keys bordering said coast. Under the approved project for improvement of this locality, adopted June 25, 1910 (see H. Doc. No. 1190, 60th Cong., 2d sess.), a channel 7 feet deep and 100 feet wide has been dredged through the lower part of Boca Ceiga Bay, and the plan contemplates the dredging of a channel of similar dimensions to connect with Tampa Bay, indicated on the accompanying map as A1. In lieu of this channel, for which funds are not available, the district officer now proposes to make the cut indicated as A2, which will not only shorten the distance between Boca Ceiga Bay and St. Petersburg and Tampa, but will effect a material saving in original outlay. The estimated cost of dredging a channel 8 feet deep and 100 feet wide through A2 is \$10,700, as compared with \$19,000 for a channel of similar dimensions through A1. He recommends that the approved project for improvement of Clearwater Harbor and Boca Ceiga Bay be modified to include the channel via A2. With reference to the proposed cut near Maximo Point, the district officer finds no commercial demand for such a channel, and for reasons stated does not recommend it. The division engineer concurs with the views of the district officer.

I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore in carrying out the instructions of Congress I report as follows: That the improvement by the United States of Boca Ceiga Bay, Fla., is deemed advisable so far as to secure an available channel depth of 8 feet and a channel width of 100 feet, increased at entrances, from Tampa Bay to Boca Ceiga Bay, in lieu of the channel contemplated by the existing project, following in general

the methods described in the report of the district officer, at an estimated cost of \$10,700 for first construction and \$1,000 annually for maintenance.

HARBOR AT ST. PETERSBURG, FLA.

Location and description.—St. Petersburg is situated on the west shore of Tampa Bay, about 17 miles from Egmont Light, 21 miles from Tampa, and $8\frac{3}{4}$ miles from Port Tampa. The harbor under improvement by the United States is an artificial basin within the shore line, called Bayboro Harbor. The basin and the channel connecting it with the bay were dredged by private interests about 1911. The basin was originally made 1,360 feet long, 450 feet wide, and 14 feet deep, and the channel was 120 feet wide and 13 feet deep.

Existing project.—The existing project, which is the original project, was adopted by the river and harbor act of July 25, 1912. (H. Doc. No. 512, 62d Cong., 2d sess.) It provides for securing in the channel from Tampa Bay into Bayboro Harbor, by dredging, an available depth of 10 feet at mean low water, with a width of 200 feet at the outer end, gradually widening to about 285 feet at the shore line, as defined by the eastern side of First Street, and for protecting the channel by the construction of a single random stone jetty on the south side. The estimated cost of the work was \$32,000, increased in 1915 to \$47,000, with \$1,500 annually for maintenance. The mean tidal variation is 1.84 feet. For latest published map, see page 2466 of the Annual Report for 1915.

Condition at the end of fiscal year.—The project is about 75 per cent completed. The channel has been dredged to full project dimensions, and the jetty is sufficiently advanced to afford considerable protection. Shoaling has occurred in the channel, and it is not improbable that a second jetty may ultimately prove necessary. The controlling depth at mean low water is about 9 feet, and the ruling width is about 100 feet. To complete the project the jetty must be extended to the 10-foot curve in the bay and brought to full height and capped throughout its length, except for the first 155 feet. The total expenditure under the existing project to June 30, 1916, has been \$33,781.64, of which \$32,688.62 was for new work and \$1,093.02 was for maintenance.

Local cooperation.—The river and harbor act of July 25, 1912, adopting the project, imposed the condition that local interests should do all necessary work inside the shore end of the jetty, including the widening of the basin 175 feet and rounding off the corner at the entrance, and the maintenance of the basin to a depth of 10 feet at mean low water; and that the city's frontage of 600 feet on the basin will be moved northward, and the land along Salt Creek be reserved for future enlargements, the exact lines to be determined by the Chief of Engineers.

In compliance with these conditions the city purchased the necessary additional frontage on the east side of the basin and the water lot lying to the east and north of the dredged channel, and adopted a plan for present and future development thereon; purchased a right of way for a municipally owned railroad to reach its property; and entered into contract for dredging the basin and the approach channel inside the eastern side of First Street. The lines and plans for future development were approved by the Chief of Engineers on

May 15, 1913, and by the Secretary of War on May 16, 1913. Evidence of the purchase of the land and the adoption of the plan, with a bond guaranteeing its execution, were submitted to the Secretary of War and accepted by him on June 15, 1914. The city has dredged the basin and the channel inside the shore line to a depth of 10 feet at mean low water and has dredged a 200-foot channel of the same depth along the face of pier No. 1 from the entrance channel to the basin. A substantial concrete wharf 300 feet long has been built on pier No. 1, adjacent to this channel, and the area behind it paved and connected with First Street by a paved roadway. The city has expended \$46,100 in this work. The funds were raised by the sale of a special issue of city bonds.

The initial work on the basin, which forms the basis of the project, was done by a local corporation, at its own expense, at a cost of about \$90,000. This work antedated the adoption of the project.

Effect of improvement.—In its incomplete state the improvement has as yet been of little benefit to commerce. It is the intention of the city to encourage the transfer of all commercial water traffic to Bayboro as soon as the work there is completed, reserving the city front for pleasure boats. The improvement has had no effect on freight rates.

Proposed operations.—Available funds will be applied to completion of the south jetty and to dredging for maintenance in the channel. Annual maintenance in this channel must be anticipated. To provide for maintenance dredging as required during the fiscal year 1918, the following estimate is submitted: For operating U. S. dredge *Sarasota* one month, \$1,500.

Commercial statistics.—The water-borne commerce for the calendar year 1915 consisted of brick, cement, fish, gasoline, fertilizer, hardware, lumber, pipe, and general merchandise. The tonnage for the year amounted to 16,486 tons, valued at \$679,623, being a decrease in tons of 36.5 per cent under the preceding year, the loss principally being made up of shell tonnage which, due to the completion of roads, is not an item in the tonnage of the present year. This tonnage was carried in steam and gasoline boats drawing 2½ to 7 feet. Only the gasoline and lumber, constituting about 28 per cent of the total, used the channel under improvement by the United States, the remainder being handled at the wharves on the city front.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	24,572	\$1,273,300
1914.....	25,780	1,067,050
1915.....	16,486	679,623

Amount expended on all projects from July 25, 1912, to June 30,

1916:

New work	\$32,688.62
Maintenance	1,093.02

Total	33,781.64
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Balance available for fiscal year ending June 30, 1917.....	17,208.36
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	1,500.00
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HILLSBORO BAY, FLA.

Location and description.—Hillsboro Bay is the eastern of the two arms into which Tampa Bay is divided by the Gadsden Peninsula. The entrance is 25 miles from the entrance to Tampa Bay. The bay is about 9 miles long and $4\frac{1}{2}$ miles wide.

Existing project.—The existing project, providing for an increase in depth to 24 feet, was adopted by the river and harbor act of June 25, 1910. (H. Doc. No. 634, 61st Cong., 2d sess.) It provides for securing and maintaining a channel 200 feet wide and 24 feet deep at mean low water from Tampa Bay to the turning basin at the mouth of Hillsboro River, following the line of the 20-foot channel secured under the previous project; thence eastwardly 300 feet wide and 24 feet deep to the mouth of the Ybor Estuary, and northwardly up the estuary to Ybor City; and a channel 200 feet wide and 24 feet deep from the mouth of the estuary southwardly through Sparkman Bay and the Tampa Northern Channel to the main channel. The improvement is to be effected by dredging and rock excavation. The estimated cost is \$1,750,000 for construction and \$20,000 per year for maintenance for the first five years after completion and \$10,000 per year thereafter. The mean tidal variation is 1.5 feet at the entrance to the bay and 2.2 feet at Tampa. For latest published map see House Document No. 634, Sixty-first Congress, second session, and Annual Report for 1914, page 2130.

Condition at the end of fiscal year.—The project is about 90 per cent completed. The main channel, Hillsboro Turning Basin, and Hendry and Knight Channel are completed to full dimensions; Ybor Turning Basin is completed except for a small area near its southern end; Ybor Channel is completed except the western half of the first 1,100 feet, where the depths, over rock, range from 17 to 22 feet, and scattered rock areas elsewhere, where the depths range from 20 to 23.5 feet; Tampa Northern Channel has been dredged to full depth, 150 feet wide, for three-quarters of its length, and partly dredged for the remainder of its area; and soft material overlying rock has been removed from Sparkman Bay Channel. The controlling depths at mean low water are 24 feet in the main channel, Hillsboro Turning Basin, and Hendry and Knight Channel; 20 feet in the Ybor Channel; and about 12 feet in Sparkman Bay-Tampa Northern Channel. To complete the project rock remaining in Ybor Channel, and rock and shoaled material in Sparkman Bay-Tampa Northern Channel and lower end of Ybor Turning Basin must be removed. The total expenditure under the existing project to June 30, 1916, has been \$1,510,770.04, of which \$1,421,639.51 was for new work and \$89,130.53 was for maintenance.

Local cooperation.—The river and harbor act of June 25, 1910, adopting the project, imposed the following conditions:

That no expenditure be made on that part of the harbor between the new turning basin and Ybor City until the Secretary of War is assured that the local municipality will construct wharves or slips having an available length not less than 1,400 feet, which shall be open for the use of the general public under reasonable regulations and charges, and also that the municipality has obtained such control of the property for at least 700 feet on each side of the proposed Ybor Channel throughout its length as will insure its use primarily in the interest of general commerce, on equal terms to all; and that all wharfage charges and regulations shall be reasonable and fully controlled by the municipal authorities and subject to the approval of the Secretary of War.

In compliance with these conditions, the city purchased 1,400 feet of frontage on the Ybor Estuary Channel, and secured from the property owners the required control of the property on each side of the estuary. The evidence submitted by the city was accepted by the Secretary of War on April 18, 1911. A plan of development of the estuary zone, submitted by the city, was approved by the Secretary of War on August 8, 1913. No actual work of a permanent character has been done toward the construction of the city's wharves or slips, and the schedule of wharfage charges and regulations has not been submitted for approval. The plans for the city's terminals are not yet fully worked out, but the cost of the work contemplated, including the purchase of land, construction of a municipal railway, and construction of wharves and slips will probably be over \$225,000. The funds will be derived from the sale of city bonds issued for the purpose and from special tax levies.

After the completion of the 20-foot project a 20-foot channel, 300 feet wide and about 3,000 feet long, was dredged by private capital eastward along the water front from the turning basin. This work was completed in 1909 at a cost of about \$95,000. While undertaken primarily as a commercial enterprise, this channel has been of great value in the development of the port. This channel known as the Hendry and Knight Channel, was adopted as part of the present 24-foot project, and is now under improvement by the United States.

In 1907 the Tampa Northern Railroad Co. dredged a 20-foot channel 100 feet wide and 2,600 feet long from the main channel to their terminals on Hookers Point. This was primarily a private enterprise; but the outer 50 feet of this channel for its entire length was adopted as a part of the 24-foot project and is now under improvement by the United States.

Effect of improvement.—The improvement, in connection with the improvement of Tampa Bay, has created a deep-water port and has provided an outlet for the immense phosphate and lumber resources of central Florida. It has made Tampa the receiving and distributing center for a large area and has contributed largely to the development of this part of the State, and has lowered freight rates probably 40 per cent.

Proposed operations.—Available funds will be applied to payments under contract in force, to repairs and alterations of the U. S. dredge *Barnard*, and to her operation in the rock area; to removal by contract of such rock as the *Barnard* is unable to remove; and to office expenses, care of plant, and miscellaneous expenses. It is expected that funds now available will be sufficient to complete the project.

In the interior channels of Tampa Harbor the currents are not sufficient to remove the large quantities of soft material brought into the channels by rain wash and the degradation of the banks and sides of the dredged cut. Shoaling in these channels, particularly in Ybor Channel, has been much greater than was anticipated, and the cost of annual maintenance, at least for the present, will be considerably more than originally estimated. After conditions along these channels become stable and the shores have been more generally protected by bulkheads and wharves, it is anticipated that the annual maintenance cost will be reduced. To provide for maintenance dredging during the fiscal year 1918, for the necessary care and upkeep of the dredging plant pertaining to the work, and for neces-

sary office and overhead expenses, the following estimate is submitted:

For operation of U. S. dredge <i>Barnard</i> , 4 months, at \$8,500	\$34,000
For care and repair of dredge <i>Barnard</i> and other plant	16,000
For office expenses, supervision, and contingencies	10,000
Total	60,000

Commercial statistics.—The water commerce for the calendar year 1915 consisted of brick, cattle, cement, coal, cigars, fish and oysters, flour, fruits, fuller's earth, grain, ice, logs and lumber, oils, phosphate, sand and shell, water, and miscellaneous merchandise. The total tonnage for the year amounted to 1,251,027 short tons, valued at \$34,699,112, a decrease in tons under the preceding year of 4.1 per cent. The total value, however, increased 2.6 per cent. The principal decreases were in phosphate, coal, and grain; the principal increases in lumber, oil, and miscellaneous merchandise. The export business is chiefly carried in ships drawing generally from 20 to 26 feet, coastwise trade in ships drawing 18 to 24 feet, and bay and local trade in steamers and launches drawing up to 8 or 9 feet. All traffic passes over some portion of the improved channels.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	1,319,283	\$36,941,311
1914.....	1,318,749	33,812,025
1915.....	1,251,027	34,699,110

Amount expended on all projects from June 14, 1889, to June 30, 1916:

New work	\$2,144,689.97
Maintenance	106,237.77

Total	2,250,927.74
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Balance available for fiscal year ending June 30, 1917	361,824.47
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	60,000.00
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TAMPA HARBOR, FLA.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1345, Sixty-fourth Congress, first session:

The improvement of Tampa Harbor is included in the existing project for Hillsboro Bay (see preceding item). The connecting channel through Tampa Bay to the Gulf of Mexico has been improved under the project for Tampa Bay, which provides for a depth of 26 feet from the Gulf to Port Tampa. The commerce of Tampa and Port Tampa has increased with marked rapidity in recent years, and now amounts to over 2,000,000 tons annually. A large part of the tonnage is of a class requiring deep-draft boats for its economical transportation, and the existing channel facilities have already been outgrown to such an extent that many vessels can not load to full capacity at Tampa and are forced to drop down into Tampa Bay to complete their loads by lighterage, or seek additional cargo at other ports. The district officer has given consideration to the advisability of providing depths of 27 and 30 feet. On account of the excessive cost of the latter depth, due chiefly to the large amount of rock excavation involved, he believes that such a depth is not now justified, but he

expresses the opinion that under certain conditions of local cooperation the harbor of Tampa is worthy of further improvement by the United States to the extent of providing a channel 27 feet deep at mean low water, from the Gulf to the head of the Ybor Estuary Channel in the city of Tampa, by way of Hillsboro Bay and the Tampa Northern-Sparkman Bay Channel, and to the turning basin at the mouth of the Hillsboro River, by way of the main channel west of Seddon Island; and also from the turning basin at the mouth of the Hillsboro River to the turning basin at the lower end of the Ybor Estuary Channel, by way of the Hendry and Knight Channel, the widths to be 500 feet on the bar, 300 feet in Tampa Bay, Ybor Estuary, and Hendry and Knight Channels, and 200 feet in Hillsboro Bay, Tampa Northern-Sparkman Bay, and Seddon Island Channels, with turning basins at the mouth of Hillsboro River and at the entrance to the estuary, as shown on accompanying maps, at a total estimated cost of \$1,425,000. The division engineer concurs in the conclusions and recommendations of the district officer.

The Board of Engineers for Rivers and Harbors concurs in the views of the district officer and the division engineer, with a slight modification of the recommended conditions of cooperation.

I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of the harbor at Tampa, Fla., is deemed advisable to the extent of providing a depth of 27 feet at mean low water from the Gulf of Mexico up to and in the several channels of Tampa Harbor, with widths as specified above, and shown on accompanying maps, at a total estimated cost of \$1,425,000 for construction, about \$25,000 a year for maintenance during construction, and \$65,000 a year for some time after completion, subject to the following conditions: That no work shall be done by the United States under such project until the city of Tampa shall have given assurances, satisfactory to the Secretary of War, that the city of Tampa will within a reasonable time, and when in his opinion the facilities are needed, acquire full ownership and possession of sufficient land for the establishment of terminals fronting on the Ybor Estuary; will complete the construction thereon of piers and slips in accordance with the plans for the development of the Ybor Estuary Zone, heretofore approved by the Secretary of War, or such modified plans as he may approve; will build adequate warehouses and storage sheds on these piers and equip them with suitable rail connections and freight-handling appliances; will construct and put in operation a municipal railroad having physical connection with all railroads entering the city of Tampa and serving the channel frontage on both sides of the estuary, in accordance with the plan of development of the estuary zone approved by the Secretary of War; will open, pave, and make available for use a sufficient number of streets and highways to give proper access to all parts of the estuary channel frontage; and will open these terminals for business under a schedule of reasonable wharfage charges and a set of regulations to be approved by the Secretary of War for the control and operation of the property fronting on the estuary channel, designed to insure its use primarily in the interests of general commerce, on equal terms to all: *And provided further*, That no work shall be done in the channels constituting the harbor of Tampa proper until local interests shall agree to provide, without cost to the United States or to any contractor for the work a suitable place for deposit of material dredged from these channels.

APALACHICOLA BAY, FLA.

Location and description.—Apalachicola Bay is situated on the coast of northwest Florida 160 miles east of Pensacola Harbor. It is about 4 miles wide and 16 miles long from east to west, opening into St. Georges Sound on the east and into St. Vincent Sound on the northwest. The bay is separated from the Gulf of Mexico by St. Georges Island and communicates with it by West Pass on the west and through St. Georges Sound by East Pass on the east. The bay is formed partially in the mouth of the Apalachicola River and partially along the coast. The town of Apalachicola, situated on the

northern shore at the mouth of the Apalachicola River, is about 15 miles from the Gulf of Mexico.

Condition at the end of fiscal year.—A timber bulkhead 9,874 feet in length has been constructed to protect the already completed 10-foot channel at the mouth of the Apalachicola River. The 18-foot channel through Link Channel and West Pass was 20 per cent completed. At the end of the fiscal year the channel at the mouth of the river had shoaled to 7 feet in depth; Link Channel to 17 feet; and West Pass to 12 feet. Bulkhead Channel was in good condition. The entire project is 80 per cent completed. The improvement has resulted in a decided increase in the depth of the channel across the bar at the mouth of the river, varying from approximately 6.5 feet to 4 feet over the original depth. The work remaining to complete the project is the completion of the channel through Link Channel and West Pass to the Gulf. That portion of the project including the 10-foot channel at the mouth of the river was completed in 1909. The old bulkhead at the mouth of the Apalachicola River was partially repaired, but is still in bad condition and needs additional work of maintenance. The total expenditures under the existing project to the end of the fiscal year were \$82,144.59 for new work and \$119,750.42 for maintenance, making a combined total of \$201,895.01.

Effect of improvement.—The improvement at the mouth of Apalachicola River has increased the facilities for commerce at this port and has resulted in a substantial reduction in freight rates to and from Apalachicola. The small amount of work accomplished on Link Channel and West Pass has had no commercial effect.

Proposed operations.—With the funds on hand at the end of the fiscal year and the funds appropriated by the river and harbor act approved July 27, 1916, it is proposed to continue repairs to the existing bulkhead at a cost of \$6,000 during the month of September, using the U. S. snag boat *Chattahoochee* and the U. S. towboat *Columbus* at an estimated monthly operating cost of \$5,500; and to dredge to the project depth the channel across the mouth of the river at a cost of \$5,000, using the dredge *Muscogee* during the months of April and May at a monthly operating cost of \$2,500. It is expected that the funds will be exhausted on June 1, 1917. Expenditures will be for maintenance.

It is estimated that \$14,000 will be needed for work of maintenance in the fiscal year 1918.

Commercial statistics.—The commerce for this harbor for the calendar year 1915 was 22,947 short tons, valued at \$1,462,948, all of which used the improvement. It consisted principally of grain, dressed and kiln-dried pine and cypress lumber, timber, naval stores, manufactured iron and steel, and miscellaneous merchandise. The usual limit of draft for loaded boats is 8 feet.

Comparative statement.

Year.	Short tons.	Value.
1913.....	42,900	\$2,027,901
1914.....	29,775	1,749,822
1915.....	22,947	1,462,948

There is no change in the nature of the commerce resulting from the improvement. The Southeastern Steamship Co. ceased operations during the calendar year 1914 and their steamer, the *Falcoln*, is now tied up at Carrabelle. The decrease from last year's report was caused by the inability to obtain bottoms for the export lumber and timber trade. This decrease is, in all probability, a temporary one.

Amount expended on all projects from 1833 to June 30, 1916:

New work-----	\$216, 758. 09
Maintenance-----	288, 516. 18
Total-----	505, 274. 27

Balance available for fiscal year ending June 30, 1917----- 11, 076. 02

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement----- 14, 000. 00

ST. ANDREWS BAY, FLA.

Location and description.—St. Andrews Bay, lying behind low sand spits and low sand islands, is located on the northwest coast of the State of Florida 110 miles east of the entrance to Pensacola Harbor. The bay proper is parallel with the coast line, is about 10 miles long by 2 miles wide, and is connected at about mid-point with the Gulf of Mexico through an arm $2\frac{1}{2}$ miles wide, extending approximately 4 miles in a southeasterly direction. East Bay is a prolongation of the main bay running from its east end and parallel to the coast for about 12 miles. At the eastern end of this bay is the entrance to the waterway between Apalachicola River and St. Andrews Bay.

Existing project.—The existing project is to secure a channel 22 feet deep and 200 feet wide through East Pass from the Gulf of Mexico to St. Andrews Bay. This project was authorized by the river and harbor act approved June 25, 1910 (see H. Doc. No. 12, 61st Cong., 1st sess.), at an estimated cost of \$203,560, with an estimated annual maintenance of \$20,000. The length of the channel to be dredged on the outer bar through East Pass was 10,000 feet, while through Camel Back Shoals the distance was 6,000 feet. The latest published map of St. Andrews Bay will be found in House Document No. 789, Sixty-fourth Congress, first session.

Condition at the end of fiscal year.—The project was completed in 1914, resulting in an increased depth over the original condition of 11 feet. The work during the past year has consisted in regaining the project depth and the project width with minor exceptions by increasing the controlling depth by 2.6 feet. The controlling depth at the end of the fiscal year at mean low water was 22 feet. The total expenditures under the existing project up to the end of the fiscal year was \$203,560 for new work and \$70,096 for maintenance, making a combined total of \$273,656.

Effect of improvement.—The effect of the improvement at this harbor has been to materially increase facilities for the entrance of deeper draft vessels, with a consequent increase of water-borne freight. It is not known whether or not the improvement has had any effect on freight rates.

Proposed operations.—With the funds available work will be continued during the month of July, 1916, using the U. S. dredge *Charleston*. This work will practically exhaust the funds.

It is estimated that \$36,000 will be needed during the fiscal year 1918, to be expended as follows: \$20,000 for maintenance of the channel by the U. S. dredge *Caucus* at a monthly operating cost of \$5,000; repairs to plant, including annual repairs to the dredge *Caucus*, \$12,000; surveys and incidental expenses, \$4,000.

Including the present fiscal year there will have been expended on maintenance at this work an average of \$35,096.52 per year for two years; this average and the above estimate is in excess of the amount originally estimated for annual maintenance, but it is to be noted that the present estimate is to cover practically all of the silting which may occur during the fiscal year 1917, as well as that which will take place in 1918. Moreover, this being a new project additional work of maintenance will be required for the first few years until the exact location of the channel most suitable for local conditions has been determined, after which it is anticipated that maintenance costs will materially decrease.

Commercial statistics.—The commerce for this harbor for the calendar year 1915 was 130,479 short tons, valued at \$3,355,902, all of which used the improvement. It consisted principally of brick, cotton, grain, lumber, timber, naval stores, and miscellaneous merchandise. The usual limit of draft for loaded boats is from 18 to 20 feet for timber products, nearly four-fifths of the total tonnage, and 8 feet for most other commodities.

Comparative statement.

Year.	Short tons.	Value.
1913.....	116,622	\$1,837,351
1914.....	115,991	2,219,380
1915.....	130,479	3,355,902

There were 1,162 tons of cotton, valued at \$278,880, shipped during the calendar year, which is the first commerce of this nature since the beginning of the improvement.

Amount expended on all projects from July 25, 1910, to June 30,

1916:

New work.....	\$203,560.00
Maintenance.....	70,096.00
Total.....	273,656.00
July 1, 1916, balance available.....	6,361.04
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	36,000.00

ST. JOHNS RIVER, FLA., JACKSONVILLE TO THE OCEAN.

Location and description.—This river rises in the marshes of Brevard County, Fla., near the east coast, and flows northwestwardly to Jacksonville, thence eastwardly into the Atlantic Ocean, 122 miles south of Savannah River. Its total length is about 285 miles.

Existing project.—The existing project, contemplating an increase in depth to 30 feet, following the methods of improvement used

under former projects, was adopted by the river and harbor act of June 25, 1910. (H. Doc. No. 611, 61st Cong., 2d sess.) It provides for securing and maintaining a channel 30 feet deep at mean low water from Jacksonville to the ocean, following generally the line of the 24-foot channel secured under the previous project, the width to be 300 feet in the straight reaches, increasing to as much as 600 feet in the bends and through the jetties, with an anchorage basin opposite Mayport ($3\frac{3}{4}$ miles from the mouth), 800 feet in width beyond the channel limits. The plan of improvement embraces two converging stone jetties at the mouth, dredging and rock excavation in the river and between the jetties and on the bar, and rock training walls and shore protection in the river, with possibly a cut-off dam in Mill Cove Channel ($12\frac{1}{2}$ miles from the mouth). The estimated cost is \$2,852,000 for construction and \$60,000 per year for the first five years after completion for maintenance. This does not include the restoration of the jetties to their original section, which may ultimately be required. The length of the section included in the project is 28 miles. The tidal variation is 5.22 feet at the bar, 4.3 feet at Mayport, 1.8 feet at Dames Point (14 miles from the mouth), and 0.8 foot at Jacksonville. For latest published map from Jacksonville to the ocean see House Document No. 611, Sixty-first Congress, second session; for latest published map of the entrance see page 2439 of Annual Report for 1915.

Condition at the end of fiscal year.—The project is about 88 per cent completed. The jetties were completed in the fiscal year 1904 to the full length now contemplated, but are not full height at the outer ends. The channel over the outer bar and between the jetties to Pilot Town has been fixed in position, widened, and deepened, but has not yet reached full project depth and width throughout. The Mayport anchorage has been dredged to a depth of 27 feet. The channel in the river has been fixed and protected by training walls, and has been dredged to full project depth and width except in Mile Point, White Shells, Dames Point, Six Mile Creek, Drummond Creek, and Arlington Cuts, where rock was found at from 26 to 30 feet. The controlling depth at mean low water is 27 feet on the bar and 26 feet to Jacksonville. To complete the project the channel over the outer bar must be deepened 3 feet, and the channel between the jetties and up to Pilot Town must be widened in portions where it is still from 100 to 200 feet less than the project width, the cuts through rock areas in the river channel must be deepened, and extensions of training walls may be required. The total expenditure under the existing project to June 30, 1916, has been \$2,545,282.88, of which \$2,342,020.58 was for new work and \$203,262.30 was for maintenance.

Local cooperation.—None is required by the appropriation act. Between 1892 and 1894 Duval County expended \$303,206.25 in building training walls and shore protection and dredging between Dames Point and Mile Point to secure an 18-foot channel through this 10-mile stretch. The funds were derived from the sale of county bonds issued for the purpose. The city of Jacksonville has practically completed a system of extensive, thoroughly modern municipal terminals with storage yards, warehouses, handling appliances, and rail connection with all railroads entering the city, and has begun to render service. The city has also begun the construction of a smaller wharf nearer the business center of the city. The cost of these terminals

will be about \$1,500,000, and the funds were raised by a special issue of city bonds.

Effect of improvement.—The improvement of this river has made possible the establishment of regular transportation facilities, resulting in the development of a large and growing water-borne commerce in coal, cement, fertilizer, phosphate, lumber, and other commodities. It has resulted in establishing favorable freight rates for the port, and it is believed that but for the improvement the rates would be at least 50 per cent higher than they are.

Proposed operations.—Funds now available will be applied to payment for work under contract for dredging and rock excavation, which should be completed by December 1, 1916, or earlier; to operating the U. S. dredges *Major J. C. Mallery* and *Key West* during the year in new work and maintenance; to annual repairs to plant, office expenses, superintendence, and contingencies during the year, and to extension of Mile Point and Fulton training walls and extension and repair of other training walls as needed. This work will complete the project, except for the Mill Cove Cut-off Dam, the construction of which will not be undertaken unless experience with the completed channel shows that its construction is necessary to the proper and economical maintenance of the project depths. It is anticipated that the work now contemplated will be finished during this fiscal year.

With funds asked for in the estimate it is proposed to restore to their original cross sections the outer portions of both jetties where they have been beaten down by the sea, to extend the north jetty shoreward 1,400 feet to eliminate the danger of flanking, and to operate and repair United States dredges and plant. The following detailed estimate is submitted.

For building up outer 4,000 feet of south jetty to original cross section, 50,000 tons of stone, at \$3-----	\$150, 000
For building up outer 1,000 feet of north jetty, 12,000 tons of stone, at \$3-----	36, 000
For extending north jetty shoreward 1,400 feet, 5,000 tons stone, at \$4; 3,000 square yards mattress, at \$1-----	23, 000
For operating U. S. dredge <i>Major J. C. Mallery</i> 4 months, at \$7,500---	30, 000
For operating U. S. dredge <i>Key West</i> 4 months, at \$3,750-----	15, 000
Care and repairs of dredges and other plant-----	40, 000
Office expenses, supervision, contingencies-----	36, 000
Total-----	330, 000

All of this work will be maintenance work. The large amount in comparison with average expenditures for maintenance in recent years is due to the necessity for extensive repairs to the jetties, to make good accumulated deterioration, and to the fact that repairs and supervision, heretofore charged to new work, must hereafter be charged to maintenance.

Commercial statistics.—The water-borne commerce for the calendar year 1915 consisted of cement, cotton, coal, stone, fertilizer, fuller's earth and kaolin, grain, iron pyrites, logs, lumber, and crossties, naval stores, oils, fruits and vegetables, phosphate, salt, sand and shell, and general merchandise. The tonnage for the year amounted to 2,238,446 short tons, valued at \$61,026,484, an increase in tons over the preceding year of 2.4 per cent. Approximately 98 per cent of this tonnage is ocean going, and is carried by steamers and sailing vessels drawing from 10 to 24 feet. The balance is river and canal

traffic, below Jacksonville, handled in steamers and gasoline boats drawing 2 to 6 or 8 feet. The entire ocean-going business benefits from the improvement, and is, in fact, made possible by it.

Comparative statement.

Year.	Tons.	Value.
1913.....	2,562,043	\$71,244,501
1914.....	2,186,678	60,718,452
1915.....	2,238,446	61,026,484

Amount expended on all projects from June 14, 1880, to June 30, 1916:

New work.....	\$5,862,157.97
Maintenance.....	746,660.82
Total	6,608,818.79

Balance available for fiscal year ending June 30, 1917.....	317,650.65
Amount (estimated) required to be appropriated for completion of existing project.....	28,260.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	330,000.00

OKLAWAHA RIVER, FLA.

Location and description.—This river has its source in the system of large lakes in the central part of the peninsula of Florida and flows in a general northerly direction, then eastwardly, emptying into the St. Johns River 22 miles above Palatka. The extreme head of the system may be taken as Lake Apopka, 120 miles above the mouth of the river.

Existing project.—The existing project, providing for the improvement of the river to a depth of 4 feet from its mouth to Leesburg on Lake Griffin, was adopted by the river and harbor act of September 19, 1890. (Annual Report for 1889, pp. 1360 to 1368.) It was modified by the river and harbor act of March 2, 1907 (H. Doc. No. 782, 59th Cong., 1st sess.), which increased the depth to 6 feet from the mouth to and including Silver Springs Run. It was extended by the river and harbor acts of June 25, 1910, and July 25, 1912, to include maintenance of the levels of the lakes at the head of the river. By act of July 27, 1916, provision was made for the acceptance of certain artificial canals and extensions thereof between Heather Island and Lake Griffin as part of the waterway in lieu of portions of the natural bed of the river, subject to the conveyance to the United States of clear title to the land occupied by the canals and extensions and a strip of land adjacent thereto of sufficient width to provide for future possible widening by the United States. As modified and enlarged, the project provides for deepening the channel to 6 feet at mean low water from the mouth to the head of Silver Springs Run, a distance of 62 miles; for clearing the channel of obstructions from Silver Springs Run to Lake Griffin, including the Kyle & Young Canal and its extension and the proposed J. D. Young Canal above Morrison's Landing after their acceptance by the United States, with a view to obtaining a navi-

gable depth of about 4 feet to Leesburg, 94 miles above the mouth; and for maintaining the levels of the lakes at the head of the river, especially Lake Griffin. The plan of improvement embraces dredging, snagging, cut-offs at sharp bends, and removal of overhanging trees and obstructive aquatic vegetation, with a lock and dam to hold up the water level in Lake Griffin if found necessary. The original estimated cost of the work proposed, exclusive of the lock and dam, was \$41,000, with \$1,600 annually for maintenance. For latest published maps see House Document No. 514, Sixty-third Congress, second session, and Annual Report for 1891, page 1626.

Condition at the end of fiscal year.—The project is about 70 per cent completed. By dredging, making cut-offs, and annual snagging and clearing, a fairly well cleared channel approximately 6 feet deep at ordinary stages, except over one or two shoals, has been obtained for the first 32 miles above the mouth, and a practicable channel about 5 feet deep at ordinary stages to the head of Silver Springs Run, 62 miles above the mouth. Above Silver Springs Run the available depth at low stages does not exceed 2 to 2½ feet. The controlling depths at the low summer stages are about 4 feet to Silver Springs Run and 2 feet to Leesburg. To complete the project some cut-offs must be made and the channel must be deepened at a number of points below Silver Springs Run, and for a good part of the distance from Silver Springs Run to Lake Griffin; and it is doubtful if the water supply in the upper river is sufficient to provide a channel 4 feet deep by dredging alone. The total expenditure under the existing project to June 30, 1916, has been \$75,555.50, of which \$33,580.44 was for new work, and \$41,975.06 was for maintenance.

Local cooperation.—None is required by the appropriation acts. The city of Leesburg has dug a canal 2,500 feet long, 100 feet wide, and 5 feet deep from Lake Griffin to a point within easy reach of the business portion of the city, and a similar canal 2,200 feet long, 100 feet wide, and 6 feet deep from Lake Harris, with the object of enabling boats to land near the mercantile and shipping section. Lake Dora has been connected with Lake Eustis by a canal 1¼ miles long, 25 feet wide, and 3 feet deep, dug by private enterprise at a cost of about \$15,000. A similar canal connects Lake Dora with Lake Apopka. These canals enable small boats to reach Lake Apopka. In 1911 the owners of a basin of muck land along the river between Heather Island (60 miles above the mouth) and Moss Bluff (72 miles above the mouth) dug a canal 4.6 miles long and about 6 feet deep and 26 feet wide near the higher land on the east side of the basin and diverted the river into the new channel, cutting off about 6½ miles of the old river. The work was done with the object of facilitating the drainage of the basin, but incidentally it has proved, on the whole, of benefit to navigation. This canal has been legalized and accepted as a public waterway, under certain conditions, by the river and harbor act of July 27, 1916.

Effect of improvement.—The improvement has facilitated the navigation of the river as far as Silver Springs and has shortened the time required for the trip. No effect on freight rates has been observed.

Proposed operations.—Available funds will be applied to dredging and removing logs, snags, overhanging trees, and other obstructions,

with a view to extending the improvement and maintaining work already done. It is proposed to operate a snagging party about four months and to dredge with hired plant about three months, doing the work during the low-water season of this fall or next spring.

With funds asked for in the estimate, it is proposed to continue the same work during the next fiscal year. The following detailed estimate is submitted:

Operation of snagging party, 3 months at \$750-----	\$2, 250
Dredging for maintenance, 1 month at \$2,250-----	2, 250
Contingencies-----	500
Total -----	5, 000

Commercial statistics.—The water-borne commerce for the calendar year 1915 consisted of crate material, grain and hay, logs, citrus fruits, and miscellaneous merchandise. The tonnage for the year amounted to 29,393 short tons, valued at \$234,786, a decrease in tonnage under the preceding year of 14.6 per cent. The greater part of this tonnage is below Silver Springs. One boat makes regular trips to points between Silver Springs and the Kyle and Young Canal. The draft of the boats using the improvement is from 2 to 5 feet.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	14, 622	\$546, 045
1914.....	34, 420	248, 991
1915.....	29, 393	234, 786

Amount expended on all projects from Feb. 14, 1835 to June 30, 1916:

New work-----	\$37, 443. 27
Maintenance -----	42, 024. 18
Total -----	79, 467. 45

Balance available for fiscal year ending June 30, 1917-----	12, 854. 50
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement and for maintenance-----	5, 000. 00

OKLAWAHA RIVER, FLA.—NEW PROJECT.

Report of the Chief Engineers, printed in House Document 514, Sixty-third Congress, second session:

The Oklawaha River has its source in numerous lakes in the central part of the peninsula of Florida and empties into the St. Johns River about 20 miles above Palatka. The existing project for its improvement provides for securing a channel 6 feet deep from the mouth of the river to the head of Silver Springs Run by dredging and removal of obstructions; a channel 4 feet deep from the mouth of Silver Springs Run to Leesburg by removal of obstructions; and to maintain the levels of the lake at the head of the river. The depths proposed have not been attained. The commerce of the stream now amounts to about 100,000 tons per annum.

The district officer is of opinion that a material development of this country would follow the construction of a reliable waterway from Lake Dora to the mouth of the river, and that a saving of about \$600,000 annually would be effected thereby. Plans and estimates of cost are submitted by him for a 6-foot channel, 60 feet wide, from the mouth of the river to Mount Dora, a 4-foot

channel, 50 feet wide, from the mouth to Mount Dora; and for a 6-foot channel from the mouth to Silver Springs Run and thence a 4-foot channel to Mount Dora. All plans contemplate improving the river from its mouth to the lower end of the Kyle Young Canal by dredging, easing bends, and constructing such cut-off dams as are essential, and by canalization above this point. He is of opinion that the river is worthy of improvement to the extent of providing a 6-foot channel from its mouth to Mount Dora under certain conditions of local cooperation, at an estimated cost of \$616,000. The division engineer concurs in general with the favorable opinion of the district officer, and attention is invited. In connection with its consideration of the subject, the Board of Engineers for Rivers and Harbors visited the locality on April 13, 1913, held a public hearing near Leesburg, and made a personal inspection of the stream. The board is in general accord with the views of the district officer and the division engineer regarding the advisability of the proposed improvement, but it believes that the lock chamber dimensions proposed should be increased from 30 feet wide by 125 feet long to 36 feet wide by 160 feet usable length. The estimated cost of the project, as thus modified, is \$733,000 and \$12,000 per annum for maintenance. The board expresses the opinion that the present and prospective commerce is sufficient to justify the United States in undertaking this improvement.

“Provided, That any land necessary for the construction of the waterway shall be given to the United States without charge; that interested property owners shall agree to protect the United States against claims for damages on account of any land that may be flooded; that local interests give satisfactory assurance that they will provide for the use of the public suitable wharf and terminal facilities in the vicinity of Leesburg; and that they will establish and operate a boat line over this waterway which will be competitive with the railroads and not subject to control or purchase by railroad and other corporate interests.”

I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Oklawaha River from its mouth to Lake Dora is deemed advisable to the extent of obtaining a channel 6 feet deep and 60 feet wide, in the manner contemplated by the district officer, and with locks of dimensions as proposed by the Board of Engineers for Rivers and Harbors, at an estimated cost of \$733,000 for original construction and \$12,000 per annum for maintenance, subject to the conditions of local cooperation recommended by the board and quoted above. The first appropriation should be \$175,000, with subsequent appropriations sufficient to complete the work in four years.

While this project was under consideration it was stated by interested parties that a plan of improvement might be devised which would drain and make available for cultivation large areas of land in addition to giving navigation facilities. This phase of the subject was investigated, and the conclusion was arrived at that the additional cost of any plan which would coordinate land drainage and reclamation with a navigation project was greater than was warranted by the amount of land which would be beneficially affected. Should the owners of the land to be benefited, however, be willing to contribute any additional sum that a project providing for the reclamation and drainage of the land would cost over the project which provides for navigation alone, such project should preferably be adopted; and it is therefore recommended that the Secretary of War be given authority to make such modifications of the project above recommended for adoption as may be approved by the Chief of Engineers and as may be necessary to provide for land drainage and reclamation, as well as for navigation, provided that no work of construction shall be undertaken on such modified project until local interests shall have deposited with the Secretary of War an amount equal to the estimated cost of such modification of the project.

INDIAN RIVER, FLA.

Location and description.—Indian River is one of the series of shallow tidal lagoons and sounds on the east coast of the peninsula of Florida, between the mainland and the keys bordering the coast. It extends from about 25 miles north of Cape Canaveral to St. Lucie Inlet. The total length of the Indian River is about 120 miles, but

the improvement covers connecting waterways to Jupiter Inlet, 17 miles south of St. Lucie Inlet.

Existing project.—The existing project, which is the original project for the section of the waterway covered by it, was adopted by the river and harbor act of July 13, 1892. (H. Doc. 168, 51st Cong., 2d sess., and Annual Report for 1891, p. 1673.) It was modified by the river and harbor act of August 18, 1894, which diverted funds to the opening of Negro Cut. (See paragraph on "Previous projects.") As now in force, the project provides for securing by dredging a continuous channel in the Indian River from Goat Creek to Jupiter Inlet, 5 feet deep at mean low water and at least 75 feet wide in the straight reaches, with as much greater width as may be required in the turns. The originally estimated cost of the work was \$14,000; increased in 1911 to \$64,000. No estimate was made for maintenance. The length of the section included in the project is 77 miles. The mean tidal variation is about 2 feet at the inlets. Elsewhere tidal effect is negligible. No map of the route has been published.

Condition at the end of fiscal year.—The project is about 75 per cent completed. Cuts have been made through all shoals, and a canal 7,450 feet long has been dug from Great Pocket to Pecks Lake, giving a channel 5 feet deep and not less than 75 feet wide, except in the canal between Great Pocket and Pecks Lake, which is 35 feet wide. The controlling depth at mean low water is 4.3 feet at Crawford's Point, where shoaling has occurred. To complete the project the canal between Great Pocket and Pecks Lake must be widened 40 feet. The total expenditure under the existing project to June 30, 1916, has been \$116,518.34, of which \$44,498.58 was for new work and \$72,019.76 was for maintenance.

Local cooperation.—Before the improvement was undertaken by the United States the Florida Coast Line Canal & Transportation Co., under charter from the State, had dredged cuts through 23 shoals between Goat Creek and Jupiter Inlet, making a continuous channel not less than 50 feet wide and 5 feet deep at low water. This work was part of a continuous canal from the St. Johns River to Biscayne Bay constructed by the company. The act adopting the project imposed the condition that no part of the money appropriated should be expended until the Florida Coast Line Canal & Transportation Co. should surrender and relinquish to the United States all the rights and privileges which it then held along the route under its State charter. The canal company formally relinquished its rights to the United States on March 31, 1894, and the deed was pronounced satisfactory by the Attorney General on April 12, 1894. The work done by the canal company thus became part of the improvement since prosecuted by the United States.

Effect of improvement.—Indian River forms part of a continuous inland waterway, partly natural and partly artificial, extending along the east coast of Florida from Cumberland Sound to Biscayne Bay. The improvement enables small craft to ply up and down the coast without incurring the dangers of the outside passage. It is used by commercial boats carrying freight and passengers to and from the towns along the river and by yachts and pleasure craft.

Proposed operations.—Funds now available will be applied to completing the improvement by widening the canal from Great Pocket to

Pecks Lake and to dredging for maintenance where required, using the U. S. dredge *Florida*. This work will be done this fall.

With funds asked for in the estimate it is proposed to dredge for maintenance where required during the fiscal year 1918. The following detailed estimate is submitted: Operation of U. S. dredge *Florida*, three months, at \$4,000, \$12,000.

Commercial statistics.—The water-borne commerce for the calendar year 1915 consisted of crate material, fertilizer, fish, grain and hay, ice, oranges and grape fruit, sand and shell, vegetables, and miscellaneous merchandise. The tonnage for the year amounted to 36,966 short tons, valued at \$1,974,239, a decrease in tons under the preceding year of 10.5 per cent. The principal items in which decrease occurred were fish and shell. The commerce is carried on in steamers and launches drawing 2 to 5 feet. About 53 per cent was through business, the balance being local, between the fishing grounds and various private landings and the nearest railroad station.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	28,119	\$1,488,270
1914.....	41,348	2,465,331
1915.....	36,966	1,974,239

Amount expended on all projects from June 15, 1844, to June 30, 1916:

New work.....	\$83,493.52
Maintenance.....	72,019.76
Total.....	155,513.28

Balance available for fiscal year ending June 30, 1917.....	20,013.38
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	12,000.00

KESSIMMEE RIVER, FLA.

Location and description.—This river now has its source in Tohopekaliga Lake, in the central part of the peninsula of Florida, and flows in a southeasterly direction, emptying into Lake Okechobee. Its total length, including several large lakes through which it flows, is about 137 miles.

Existing project.—The existing project, which is the original project, was adopted by the river and harbor act of June 13, 1902. (H. Doc. No. 176, 57th Cong., 1st sess.) It provides for securing a channel width of 30 feet and depth of 3 feet at ordinary low stage from the town of Kissimmee, on Lake Tohopekaliga, to Fort Bassenger, 37½ miles above the mouth, and also in Istokpoga Creek, a small tributary entering 10½ miles above Fort Bassenger, at an estimated cost of \$24,220.90, the estimate, however, being based on a channel width of but 25 feet in Istokpoga Creek. The plan of improvement embraces dredging through shoals, removing snags and overhanging trees, and building pile and brush dams and training walls to close subsidiary channels and concentrate the flow in the main channel. The length of the section included in the project is 99½ miles in the

Kissimmee River, the lakes and the canals, and 9.4 miles in Istokpoga Creek. The lower end of the section is $37\frac{1}{2}$ miles from the mouth of the river. For latest published map, see House Document No. 137, Sixty-third Congress, first session.

Condition at the end of fiscal year.—The project was completed in the fiscal year 1909. Channels of project dimensions were dredged through obstructive shoals, snags, and overhanging trees were removed, and sheet pile bulkheads and brush and pile dams were built where necessary to confine and direct the flow. The result of this work was a channel of the full project dimensions from Kissimmee to Fort Bassenger, and in Istokpoga Creek. Shoaling has occurred, however, and redredging and the reconstruction of some of the old dams, and the construction of additional dams are required. The limiting depth is now about $2\frac{1}{2}$ feet at ordinary low stages. During extreme low stages that sometimes occur steamboat navigation is practically suspended. The total expenditure under the existing project has been \$32,477.46, of which \$23,479.18 was for new work and \$8,998.28 was for maintenance. The project was completed for \$741.72 less than the original estimate.

Local cooperation.—None is required by the appropriation acts. The canals connecting the lakes, though dug primarily for another purpose, extended navigation to the upper lakes, and form a useful and important part of the present waterway. Local residents have dredged cut-offs through several of the worst bends and have removed obstructions from the stream at their own expense. To compensate for the lowering of the surface of Lake Okechobee, which is a feature of its plan for the drainage and reclamation of the Everglades, the State of Florida has agreed to build a lock and dam near the mouth of the Kissimmee River and dredge a channel in the river from the lake to the lock, or to do other work necessary to coordinate the improvement of the river for navigation with the State's scheme of drainage operations. No construction work has been done under this arrangement.

Effect of improvement.—The improvement has bettered the service and lowered the cost of transportation for a large territory without other means of communication by enabling boats to run with greater dispatch and regularity.

Proposed operations.—Available funds will be applied to dredging snagging, and rebuilding bulkheads and cut-off dams, for maintenance during the year.

With funds asked for in the estimate it is proposed to continue work of this nature during the fiscal year 1918, as follows:

Operation of United States dredge and snagging party, 2 months, at \$1,500	\$3, 000
Building bulkheads and cut-off dams	1, 000
Total	4, 000

Commercial statistics.—The water commerce for the calendar year 1915 consisted of citrus fruits, crate material, fertilizer, fish, hides and skins, lumber, naval stores, vegetables, wood, wool, and general merchandise. The tonnage for the year amounted to 73,565 short tons, valued at \$1,164,045, a gain over the tonnage of the preceding year of 99.3 per cent. the gain being due to a greater depth of water

in the river than obtained during the year 1914. This tonnage is handled in light-draft steamers, launches, and barges.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	85,550	\$3,558,400
1914.....	36,902	828,890
1915.....	73,565	1,164,045

Amount expended on all projects from June 13, 1902, to June 30, 1916:	
New work.....	\$23,479.18
Maintenance	8,998.28
Total.....	32,477.46
Balance available for fiscal year ending June 30, 1917.....	3,436.19
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	4,000.00

KISSIMMEE RIVER, FLA.—NEW PROJECT.

Abstract from the report of the Chief of Engineers, printed in House Document 137, Sixty-third Congress, first session :

The Kissimmee River has been improved under a project adopted in 1902, which provides for a channel 3 feet deep at ordinary low-water stages and from 30 to 60 feet wide for about 99.5 miles from the town of Kissimmee to Fort Bassenger. The limiting depth in this stretch is now about 2 feet, and in the stretch of about 37.5 miles from Fort Bassenger to Lake Okechobee there is a tortuous channel with minimum depths of 5 feet. Although the amount of commerce handled is small, the special board is of opinion that this river is worthy of improvement to the extent of maintaining at mean low-water stages a 3-foot channel over the entire 137 miles from Kissimmee to Lake Okechobee, for which a light-draft dredge and tender will be required, at an estimated cost of \$35,000 for construction, \$12,000 for dredging the first year, and \$6,000 for six months' operation annually thereafter. The special board is also of the opinion that if the operations of the State are successful it should be required to construct at its own expense a lock and dam at the mouth of the Kissimmee River and to dredge a channel from this lock to the 6-foot curve in the lake.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to the board's report herewith, dated May 5, 1913. The board concurs with the special board in believing that it is advisable for the United States to maintain a 3-foot channel in the Kissimmee River from Kissimmee to Lake Okechobee.

I concur in general with the views of the special board and the Board of Engineers for Rivers and Harbors, and therefore, in carrying out the instructions of Congress, I report as follows: That the improvement by the United States of Kissimmee River is deemed advisable to the extent of maintaining a channel of at least 3 feet depth and 30 feet width at mean low water throughout the 137 miles from Kissimmee to Lake Okechobee, following in general the methods described in the report of the special board, at an estimated cost of \$35,000 for the construction of a dredge, \$12,000 for the first year's work, and not exceeding \$6,000 a year thereafter for maintenance.

CALOOSAHATCHEE RIVER, FLA.

Location and description.—This river now has its source in Lake Okechobee, in the southern part of the peninsula of Florida, and flows in a general southwesterly direction, emptying into San Carlos

Bay, an arm of the Gulf of Mexico, about 20 miles south of the entrance to Charlotte Harbor and 90 miles south of the entrance to Tampa Bay. Its total length is about 84 miles. For the lower 17 miles the river has the characteristics of a tidal estuary from one-half mile to $1\frac{3}{4}$ miles in width. Above the estuary the width varies from 75 to 350 feet.

Existing project.—The existing project for the lower river, contemplating an increase in the depth authorized by the previous project from the Gulf of Mexico to Fort Myers, was adopted by the river and harbor act of July 25, 1910. (R. and H. Com. Doc. No. 8, 61st Cong., 2d sess.) The existing project for the upper river, which is the original project for the stream above Fort Myers, was adopted by the river and harbor act of August 11, 1888. (Annual Report for 1887, p. 1236; Annual Report for 1888, p. 1095.) As now in force, the project provides for securing and maintaining a channel 200 feet wide and 12 feet deep over the bar at the entrance to Puntarasa, and 100 feet wide and 10 feet deep; thence to Fort Myers, with a turning basin at that point and a practicable channel 4 feet deep from Fort Myers to Fort Thompson. The plan of improvement embraces dredging on the bar and in the river below Fort Myers, dredging through the shoal at Beautiful Island, above Fort Myers, and protecting the dredged cut by a pile, brush, and stone training wall, and removing loose rocks, logs, snags, and overhanging trees from the river between Fort Myers and Fort Thompson. The estimated cost of the work below Fort Myers was \$119,000, with \$2,000 annually for maintenance; that for the upper river was \$11,000; later increased to \$13,647, with \$1,000 per annum for maintenance. The total estimated cost of all work contemplated is \$132,647, with \$3,000 per annum for maintenance. The length of the section covered by the project is 20 miles from the entrance to Fort Myers and 43 miles from Fort Myers to Fort Thompson. The mean tidal variation is 1.6 feet at the mouth and at Fort Myers. At low-river stages tidal effect is perceptible at Labelle, 59 miles from the mouth. For latest published map of the river, see House Document No. 137, Sixty-third Congress, first session.

Condition at the end of fiscal year.—The project for the upper river was completed in the fiscal year 1891, and that for the river below Fort Myers in the fiscal year 1913. Snags, sunken logs, boulders, and overhanging trees were removed from the river between Fort Myers and Fort Thompson, and a channel 5 feet deep and of sufficient width for navigation was dredged through the shoal at Beautiful Island and protected by a dike built of piles and brush covered with material dredged from the shoal. The result of this work was a good navigable channel not less than 4 feet deep from Fort Myers to Fort Thompson. A channel 200 feet wide and 12 feet deep at mean low water was dredged from the 12-foot contour in the Gulf to Punta Rassa at the mouth of the river, a distance of 3.2 miles, and thence 100 feet wide and 10 feet deep at low water through obstructing shoals to Fort Myers. The result was a channel of project dimensions from the Gulf to Fort Myers, a distance of 20 miles. For the past three years navigation above Denaud (35 miles from the mouth) has been seriously hampered by lack of water due to the lowering of Lake Okechobee by the State's drainage operations. The

controlling depth is 12 feet at mean low water from the Gulf of Mexico to Punta Rassa and 10 feet to Fort Myers, 4 feet from Fort Myers to Fort Denaud (35 miles), and 2 feet to Labelle. Above Labelle navigation is practically suspended. The total expenditure under the present project to June 30, 1916, has been \$179,835.86, of which \$119,502.89 was for new work below Fort Myers, and \$17,993.17 was for new work, and \$42,339.80 was for maintenance between Fort Myers and Fort Thompson. This includes \$4,353.33 expended for new work between Fort Myers and Fort Thompson before the formal adoption of the present project.

Local cooperation.—None is required by the appropriation acts. The canals connecting the river with Lake Okechobee, through Lake Hicpochee, together with the removal of a rock ledge at Fort Thompson and four cut-offs below that point, though dug primarily for another purpose, have incidentally opened up a water route into the interior of the State, and form a useful and important part of the present waterway. To compensate for the lowering of the surface of Lake Okechobee, which is a feature of its plan for the drainage and reclamation of the Everglades, the State of Florida has agreed to dredge a channel not less than 40 feet wide from the lake to Labelle, the bottom sloping from elevation 11 at the lake to elevation 1 at Labelle, or do other work necessary to coordinate the improvement of the river for navigation with the State's scheme of drainage operations. This work is now in progress, and will be completed this year. The cost will be about \$180,000. The State has also awarded a contract for the construction of a lock with wing walls at the head of the Caloosahatchee River. The proposed dimensions of the lock are 30 feet wide, 130 feet long (usable length), with upper sill at elevation 8 and lower sill at elevation 6, and its completion is fixed for December 1, 1916. The cost of this work is estimated at \$42,500.

Effect of improvement.—The improvement at the entrance and in the lower river has made it possible for coastwise vessels of moderate draft to reach Fort Myers, and regular service is maintained between that point and Tampa and Key West. The improvement of the upper river has made regular service possible between Fort Myers and the several towns and many fruit farms on the river. As no railroads enter this territory, these settlements are dependent on the river for the transport of their supplies and produce.

Proposed operations.—Available funds will be applied to dredging and snagging, for maintenance, using United States plant. This work will be begun when the State's work at the head of the river has advanced sufficiently to restore the normal flow in the stream. It is anticipated that this will be effected this fall.

Funds asked for in the estimate will be applied to dredging and snagging for maintenance, as required during the fiscal year 1918. The following detailed application is proposed: For operating U. S. dredge *Sarasota* and snag boat *Kissimmee*, two months. at \$2,000. \$4,000.

Commercial statistics.—The water-borne commerce for the calendar year 1915 consisted of cattle, crate material, fertilizer, fish and oysters, citrus fruits, ice, naval stores, shell, vegetables, and miscel-

laneous merchandise. The tonnage for the year amounted to 69,340 short tons, valued at \$1,980,014, a decrease in tonnage under the preceding year of 12.3 per cent. The decrease is mainly in the items of citrus fruits and shell. The money valuation is slightly in excess of the total for the preceding year.

About 32 per cent of the tonnage uses the upper river, being carried in light-draft steamboats, launches, and lighters drawing 2 to 4 feet. About 66 per cent is carried through the entrance channel below Fort Myers in vessels drawing 3 to 10 feet.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	112,593	\$3,119,950
1914.....	79,107	1,917,494
1915.....	69,340	1,980,014

Amount expended on all projects from Aug. 2, 1882, to June 30, 1916:

New work	\$146,952.65
Maintenance	42,339.80
Total	189,292.45

Balance available for fiscal year ending June 30, 1917.....	5,641.60
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	4,000.00

MANATEE RIVER, FLA.

Location and description.—This river rises in the western part of the peninsula of Florida and flows westwardly, emptying into Tampa Bay at its southern end and near the entrance. Its total length is about 45 miles. For the first 12 miles above the mouth the river is a tidal estuary from one-half mile to 1 mile in width. From the head of this estuary to Rye, 22 miles above the mouth, the width decreases from about 600 feet to about 80 feet.

Existing project.—The existing project was adopted in part by the river and harbor act of August 2, 1882, which provided for the improvement of the entrance from Tampa Bay to McNeills Point. (See Annual Report for 1882, p. 1319.) It was modified by the river and harbor act of June 3, 1896, which provided for a cut-off into Terra Ceia Bay. It was further modified by the river and harbor act of March 3, 1905, extending the improvement to Rye. (H. Doc. No. 117, 58th Con., 2d sess.) The river and harbor act of July 27, 1916, fixes the upper limit of the improvement at the Mitchellville Bridge. As modified and extended, the project provides for a channel 100 feet wide and 13 feet deep at mean low water from Tampa Bay by Shaws Point to McNeills Point (4 miles), 100 feet wide and 9 feet deep at mean low water to Rocky Bluff (12 miles), and 75 feet wide and 4 feet deep to Mitchellville Bridge at Rye (24 miles), with a cut-off 100 feet wide and 6 feet deep from the river 2½ miles above its mouth into Terra Ceia Bay. The method of improvement is by dredging. The original estimates of cost were

\$70,000 for the improvement at the mouth, \$20,000 for the Terra Ceia cut-off, and \$53,710 for the improvement from McNeills Point to Rye. The latest consolidated estimate of cost of all work covered by the project and its modifications is \$137,710. Maintenance is estimated at \$5,000 per annum. The length of the section included in the project is 22 miles in the river and 0.66 mile in the Terra Ceia cut-off. The mean tidal variation is 1.6 feet at the mouth of the river, 1.3 feet at Rocky Bluff, and at low-river stages the tide is perceptible at Rye. For latest published map see Rivers and Harbors Committee Document No. 2, Sixty-fourth Congress, first session.

Condition at the end of fiscal year.—The project was practically completed during the fiscal year 1916. Channels of project dimensions have been dredged as contemplated, except for about 200 feet on the outer bar, where the depth obtained is from 0.5 to 1 foot less than project depth. Full depth has been restored in channels which had shoaled. To complete the project, a small amount of rock must be removed from the cut through the bar at the entrance, but this is not pressing, and will be deferred. The controlling depths at mean low water are 12 feet to McNeills Point, 9 feet to Rocky Bluff, 4 feet to Rye, and 6 feet in Terra Ceia cut-off. The total expenditure under the existing project, including all modifications and extensions, has been \$195,042.73, of which \$123,349.56 was for new work and \$71,693.17 was for maintenance.

Effect of improvement.—The improvement has made possible the establishment of daily boat service between lower Manatee River points and St. Petersburg and Tampa, and the improvement to Rye gives an outlet to the products of the upper valley. The establishment of water competition has probably kept freight rates considerably below what they would have been without such competition.

Proposed operations.—Funds now available will be applied to maintenance dredging with U. S. dredge *Sarasota*, between September 1 and December 1. It is expected that about three months dredging, at a field cost of \$1,500 per month, will be required.

Annual maintenance must be anticipated on this river. To cover the cost of maintenance for the fiscal year 1918, the following estimate is submitted:

For operation of U. S. dredge <i>Sarasota</i> , three months, at \$1,500_____	\$4, 500
Contingencies_____	500
Total_____	5, 000

Commercial statistics.—The water-borne commerce for the calendar year 1915 consisted of fullers earth, logs and lumber, naval stores, fertilizers, fruits and vegetables, oils, oranges, building sand, and miscellaneous merchandise. The total tonnage for the year amounted to 41,829 short tons, valued at \$1,277,069, an increase in tons over the preceding year of 21.2 per cent, though the value decreased because of a falling off in the movement of vegetables, which more than offset the increased tonnage of less valuable products. Of the total tonnage reported, about 37 per cent used the river above Bradentown, being carried in light-draft launches and lighters. All tonnage used the river below Bradentown. The principal boats draw from 3 to 8 feet.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	44,620	\$1,877,880
1914.....	34,057	1,289,316
1915.....	41,829	1,277,069

Amount expended on all projects from Aug. 2, 1882, to June 30, 1916:

New work	\$123,349.56
Maintenance	71,693.17
Total	195,042.73

Balance available for fiscal year ending June 30, 1917.....	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	5,000.00

ANCLOTE RIVER, FLA.

Location and description.—This river rises in the western part of the peninsula of Florida and flows southwestwardly, emptying into the Gulf of Mexico about 38 miles north of the entrance to Tampa Bay. Its total length is about 20 miles.

Existing project.—The existing project, which is the original project, was adopted by the river and harbor act of March 3, 1899. (H. Doc. No. 200, 55th Cong., 2d sess.) It provides for securing a channel 100 feet wide and 6 feet deep at mean low water from Anclote Anchorage, in the Gulf of Mexico, to Sponge Harbor, inside the river, and thence 4 feet deep at mean low water to the county bridge at Tarpon Springs, to be obtained by dredging through the shoals, at an estimated cost of \$51,500. The length of the section included in the project is about 4½ miles. The tidal variation is about 1.5 feet at the entrance and 2 feet at Tarpon Springs. For latest published map, see House Document No. 18, Sixty-third Congress, first session.

Condition at the end of fiscal year.—The project was reported completed in the fiscal year 1911. An easily navigated channel has been dredged generally to project dimensions from the Gulf of Mexico to Tarpon Springs, though scattered rock areas are found within the channel limits over which less than project depth exists. The controlling depth at mean low water is about 5½ feet to Sponge Harbor and 4 feet to Tarpon Springs. The total expenditure under the existing project to June 30, 1916, has been \$61,714.70, of which \$51,651.50 was for original work and \$10,063.20 was for maintenance.

Effect of improvement.—The improvement has resulted in making Tarpon Springs the headquarters for the sponging fleet on the west coast and the most important sponge market in the United States. Freight rates have been reduced approximately 20 per cent.

Proposed operations.—Funds now available will be applied to annual maintenance work, probably in December or January. The work will be done with the U. S. dredge *Sarasota*. About two months' work is anticipated, at \$1,500 per month.

Annual maintenance is to be anticipated, and the funds requested for the fiscal year 1918 will be applied to this purpose. The detailed

estimate is as follows: For operating U. S. dredge *Sarasota* two months, at \$1,500, \$3,000.

Commercial statistics.—The water commerce for the calendar year 1915 consisted of fertilizer, fish, general merchandise, ice, logs, lumber, ship chandlery, sponges, and wood. The tonnage for the year amounted to 11,269 short tons, valued at \$990,729, a decrease in tons under the preceding year of 20 per cent, chiefly due to smaller movement of pine logs. There are no regular boats in the trade to other ports, the commerce of the river being largely incident to the sponge and other fisheries and the rafting and lightering of logs and lumber. The sponging vessels in use draw from 4 to 5 feet.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	22,730	\$1,381,700
1914.....	14,095	1,051,250
1915.....	11,269	990,729

Amount expended on all projects from Mar. 3, 1899, to June 30, 1916:

New work.....	\$51,651.50
Maintenance	10,063.20
Total	61,714.70

Balance available for fiscal year ending June 30, 1917..... 3,000.00

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement 3,000.00

REMOVING THE WATER HYACINTH FROM NAVIGABLE WATERS IN THE STATE OF FLORIDA.

Location and description.—The water hyacinth is found in the fresh-water streams and lakes in various parts of the State, and at times has become a serious obstruction to navigation on the St. Johns River and its tributaries, the Withlacoochee River and its tributaries, and the Caloosahatchee and Kissimmee River system.

Original condition.—The water hyacinth is not native in Florida, but is said to have been introduced in Florida waters about 1890. It spread rapidly, and before operations for its removal were begun the rivers affected were not infrequently so blocked with floating masses of the plant that navigation was seriously impeded and the rafting of logs, on which the lumber industry was dependent, was at times entirely stopped.

Existing project.—The project was adopted by the river and harbor act of March 3, 1899, and originally contemplated the destruction of the plants, so far as they constitute an obstruction to commerce, by crushing with a mechanical device installed on a steamer, using log booms to close sloughs and backwaters as an auxiliary means. The cost of equipping a suitable vessel and operating it for one year was estimated at \$36,000. The project was modified by the river and harbor act of June 13, 1902, which authorized the use of any mechanical, chemical, or other means whatsoever to effect the purpose. The

project was again modified by the river and harbor act of March 3, 1905, which prohibited the use of any chemical process injurious to cattle which may feed upon the plant. As modified, the project provides for the destruction or removal of the water hyacinth in the navigable waters of the State, so far as they constitute an obstruction to commerce, using any mechanical, chemical, or other means that is not injurious to cattle. No estimate of the final cost of the work has been made.

Condition at the end of fiscal year.—Plans for a vessel and crushing plant were partially prepared, but this method was abandoned as a result of experience with a similar outfit in Louisiana. Spraying with an arsenical solution was tried with success, but had to be abandoned because it proved injurious to cattle feeding on the plants. Breaking up the packs and drifting them out with the current was practiced with success in some streams. In 1909 a hyacinth elevator, consisting of a catamaran scow carrying an inclined conveyor driven by a gasoline engine, was devised and proved successful. In 1916 a large grapple operated by a hoisting engine was used with marked success. By these various means the St. Johns River and its more important tributaries, the Orange River, and portions of the Withlacoochee and Kissimmee Rivers were cleared of the hyacinth, so far as it obstructed navigation. New growths of the plant were destroyed in the St. Johns and Withlacoochee Rivers and their tributaries, and obstructions which caused the hyacinth to collect were removed. This work relieved navigation materially on all these streams, particularly on the St. Johns River. The St. Johns River and its principal tributaries are now practically free from obstructive hyacinths. In the Withlacoochee River the hyacinth is still troublesome, and a considerable length of the middle and lower portion of the river is now blocked. No serious trouble is at present experienced on other streams in the State. The total expenditure to June 30, 1916, has been \$149,355.48, all of which is classed as for maintenance.

Local cooperation.—None is required by the appropriation acts. Individuals and transportation companies have done a considerable amount of work at their own expense in clearing the plant and obstructions which cause it to collect, from portions of the navigable streams in which they were particularly interested. The cost of the work is not ascertainable, but in the aggregate it has been considerable.

Effect of improvement.—The work done has directly benefited navigation by abating the delays and stoppages formerly experienced when the growth of the plant was unchecked. It has reduced the uncertainties and cost of water transportation on many streams, but has had no direct effect on freight rates.

Proposed operations.—Funds now available will be applied to removing the hyacinths during the year from streams on which it collects in masses sufficient to constitute an obstruction to navigation, using the hyacinth elevator and other improved methods. It is proposed to begin work on the Withlacoochee River at an early date, and it is anticipated that work on that stream will be completed by December. The dates of work on other streams can not now be stated.

Funds furnished under the estimate submitted will be applied to the destruction of the hyacinth, where necessary, during the fiscal year 1918. The following estimate is submitted:

For operations of hyacinth elevators on St. Johns and Withlacoochee	
Rivers and tributaries-----	\$5,000
For removing hyacinths by other means-----	5,000
Total -----	10,000

Commercial statistics.—The commerce benefited embraces part of that carried on the various streams of the State, but no exact statistics directly pertaining to this work can be given.

Amount expended on all projects from Mar. 3, 1899, to June 30, 1916, maintenance -----	\$149,355.48
Balance available for fiscal year ending June 30, 1917-----	11,661.32
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	10,000.00

APALACHICOLA RIVER, FLA., INCLUDING THE CUT-OFF, LEE SLOUGH, LOWER CHIPOLA RIVER, AND UPPER CHIPOLA RIVER FROM MARIANNA TO ITS MOUTH.

APALACHICOLA RIVER, THE CUT-OFF, LEE SLOUGH, AND LOWER CHIPOLA RIVER.

Location and description.—The Apalachicola River is formed at the southwest corner of the State of Georgia by the junction of the Apalachicola and Flint Rivers, and flows south a distance of 106 miles, emptying into Apalachicola Bay. About 42 miles above the mouth of the river a cut-off $1\frac{1}{2}$ miles long leaves the river and a certain part of the water from the river passes through this cut-off and thence through Lee Slough, $6\frac{1}{2}$ miles long, and lower Chicola River, $8\frac{1}{2}$ miles long, and reenters the Apalachicola River about 29 miles above its mouth. The general direction of the cut-off is west and of Lee Slough and lower Chipola River south and southeast.

Existing project.—The existing project provides for a 6-foot channel at low water 100 feet wide, to be secured by the removal of snags and overhanging trees and by widening and straightening Moccasin Slough, this project being authorized by the river and harbor act approved June 23, 1874. (See H. Doc. No. 241, 42d Cong., 2d sess.; also Annual Report for 1873, p. 698.) The estimated cost was \$80,333 for new work, no estimate for maintenance being given. The project was modified by the river and harbor act approved June 13, 1892, to include within its scope a 5-foot channel 60 feet wide through the cut-off, Lee Slough, and lower Chipola River. (Annual Report for 1889, p. 1416.) The estimate for this additional work was \$7,500. No estimate for maintenance was made. No map of Apalachicola River has been published in congressional documents. A map of the cut-off, Lee Slough, and lower Chipola River will be found in the Annual Report for 1891, opposite page 1696.

Condition at the end of fiscal year.—Dredging, contracting works, and removal of obstructions have resulted in obtaining and maintaining the project channel throughout the main river, except at Blountstown Bar, where the available depth and the controlling depth of the river is $3\frac{1}{2}$ feet. Through the cut-off, Lee Slough, and lower Chipola the project dimensions exist throughout, the con-

trolling depth being 5 feet. This project is 97 per cent completed, and with the exception noted above has resulted in straightening the channel throughout, the removal of obstructions, and the deepening of channels in bars from 3 to 4 feet. Vessels requiring $3\frac{1}{2}$ feet can navigate the main river throughout the year, deeper draft being obtainable generally from January to August, inclusive. In the cut-off, Lee Slough, and lower Chipola 5 feet draft can be carried throughout the year and deeper draft ordinarily from January to August. There are no reference gauges on this stream. With the dredging of the channel and the erection of contracting works at Blountstown Bar the project will be completed. The project for the cut-off, Lee Slough, and lower Chipola was completed during the fiscal year. At the end of the fiscal year completed works were in good condition except some existing jetties at Blountstown Bar, which are in need of repair. The total amount expended under the existing project to the end of the fiscal year was \$92,554.60 for new work and \$66,522.97 for maintenance, making a total of \$159,077.57.

Effect of improvement.—The improvement is essential to a large section of the State of Florida, which has no other means for transportation of necessary supplies. Its effect on reduction of freight rates extends through its tributaries far into Georgia and Alabama. River rates are lower than corresponding rail rates.

Proposed operations.—With the funds available at the end of the fiscal year and the funds appropriated by the river and harbor act approved July 27, 1916, it is proposed to dredge at Blountstown Bar from January 1 to March 1, at a cost of \$5,000, using hired labor and the U. S. dredge *Muscogee*, at a monthly operating cost of \$2,250, and to repair jetties at the same place during one month of the same period, at a cost of \$2,000, using hired labor with the towboat *Chattahoochee*, at a monthly operating cost of \$1,500.

It is estimated that \$26,000 will be needed during the fiscal year 1918 to be used for continuing the improvement by constructing contraction works at Blountstown Bar, at a cost of \$18,000, using hired labor, with U. S. towboat *Columbus* and U. S. snag boat *Chattahoochee*, at a monthly operating cost of \$6,500. Maintenance work in the main river of snagging, cutting overhanging trees, and dredging will be carried on by hired labor, at a cost of \$8,000, using the U. S. snag boat *Flint* and the U. S. dredge *Muscogee*, at monthly operating costs of \$1,400 and \$2,250, respectively.

Commercial statistics.—The commerce of this stream for the calendar year 1915 was 94,418 short tons, valued at \$7,802,535, all of which used the improvement. It consisted principally of cotton, fertilizer, fruit, grain, hay and feed, logs, lumber, sugar, honey and sirup, naval stores, and miscellaneous merchandise. The usual limit of draft for loaded boats is 4.5 feet.

Comparative statement.

Year.	Short tons.	Value.
1913.....	153,732	\$13,498,409
1914.....	122,097	12,954,540
1915.....	94,418	7,802,535

There is no change in the nature of the commerce resulting from the improvement. The decrease from last year's report was due to the unsettled condition of the cotton, lumber, timber, and naval stores market and is in all probability a temporary one. The large decrease in valuation was due to the excessive valuation of miscellaneous merchandise reported by the steamboat people for the year 1914.

UPPER CHIPOLA RIVER, FLA., FROM MARIANNA TO ITS MOUTH.

Location and description.—The upper Chipola River is a nontidal stream, rising in the southeast portion of the State of Alabama and flowing in a general southerly direction through Alabama and northwest Florida for a distance of about 125 miles, emptying into Apalachicola River through Lee Slough and lower Chipola River. For the last 10 miles the upper Chipola River widens into a broad sheet of water filled with cypress trees and known as the Dead Lakes. The cut-off referred to in the description of the Apalachicola River joins the upper Chipola River at the lower end of the Dead Lakes.

Existing project.—The existing project provides for securing a channel 3 feet deep and 60 feet wide from Marianna to the foot of the Dead Lakes, a distance of 55 miles, by rock excavation and snagging at an estimated cost of \$41,000, exclusive of the cost of the necessary plant. This project was authorized by the river and harbor act approved March 3, 1899. (See Annual Report for 1889, p. 1416.) No estimate for maintenance was made. No map of the upper Chipola River has been published in any congressional documents or annual report.

Condition at the end of fiscal year.—Dredging, snagging, and open-river work had resulted in obtaining the project depth throughout the improvement from the foot of the Dead Lakes to Look and Tremble Shoals, the project width being also available throughout this same stretch except at Maynards Cut and Sister Island. Practically no work has been done at Look and Tremble Shoals, or above this point to Marianna, a distance of approximately 20 miles. The existing project was about 75 per cent completed at the end of the fiscal year and resulted in increasing the depth through the portion where work has been done by approximately 1 foot and in straightening tortuous channels and removing snags and other obstructions. Vessels requiring 3 feet of water can navigate the river as far as Look and Tremble Shoals throughout the year, and vessels in excess of this draft can generally operate the river between the months of January and August. Above Look and Tremble Shoals the river is not navigable, except at high stages, by anything except rafts. There are no gauges on this stream.

The work remaining to complete the project is the improvement of the river from and including Look and Tremble Shoals to Marianna, which would probably require the construction of a lock to carry deep water across those shoals. The total expenditures under the existing project to the end of the fiscal year were \$36,781.12 for new work and \$10,391.40 for maintenance, making a combined total of \$47,172.52.

Effect of improvement.—The improvement between the foot of the Dead Lakes and Look and Tremble Shoals is essential to a section

of the State which is not provided with other means of transportation. No benefit has been derived from the expenditure above Look and Tremble Shoals. It is not known whether freight rates have been affected.

Proposed operations.—With the funds on hand at the close of the fiscal year and the funds appropriated by the river and harbor act approved July 27, 1916, it is proposed to continue snagging operations from the mouth of the Dead Lakes to Look and Tremble Shoals during the period from January 1, 1917, to April 1, 1917, using the U. S. snag boat *Flint* with hired labor, at a monthly operating cost of \$1,400, and at a total cost of \$2,000 for the work. These operations will be carried on in conjunction with the operations on the Apalachicola River and it is impracticable to state just at what time during this period the work on the upper Chipola River will be done. Repairs to plant and surveys will be made where required and the necessary office force employed.

For the fiscal year 1918 it is estimated that there will be required \$5,000, which will be used for maintaining the improvement by the removal of snags and overhanging trees and other similar obstructions from the foot of the Dead Lakes to Look and Tremble Shoals. This estimate for maintenance is larger than the average expenditure during the previous three years, due to the fact that during these years complete snagging operations throughout the entire improvement have not been carried on, it being anticipated that during the fiscal year 1918 an additional plant will be available which will permit a complete clearing out of the entire river as far as Look and Tremble Shoals. It is contemplated that the work will be done by the U. S. snag boat *Flint* operated by hired labor at a monthly operating cost of \$1,400.

Commercial statistics.—The commerce for this stream for the calendar year 1915 was 10,419 short tons, valued at \$428,695, all of which used the improvement. It consisted principally of grain, hay and feed, logs, naval stores, and miscellaneous merchandise. The usual limit of draft for loaded boats is 3 feet.

Comparative statement.

Year.	Short tons.	Value.
1913.....	10, 006	\$319, 792
1914.....	7, 337	352, 205
1915.....	10, 419	428, 695

There is no change in the nature of the commerce resulting from the improvement.

Amount expended on all projects from 1825 to June 30, 1916:

New work	\$142, 335. 72
Maintenance	76, 914. 37
Total.....	219, 250. 09

Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement.....	18, 000. 00
For maintenance of improvement	13, 000. 00
Total.....	31, 000. 00

HOLMES RIVER, FLA.

Location and description.—The Holmes River rises in the southeast corner of the State of Alabama, near the State line. It flows southwesterly through Alabama and Florida for a distance of about 60 miles, emptying into the Choctawhatchee River at a point $27\frac{1}{2}$ miles above its mouth.

Existing project.—An appropriation for this river was made as early as 1844, but apparently under no definite project. The river and harbor act of August 11, 1888, adopted a project for securing a navigable channel from the mouth to Vernon, Fla., a distance of 25 miles, by the removal of logs, snags, and overhanging trees, at an estimated cost of \$5,000. (See Annual Report for 1882, p. 1308.) No estimate of maintenance was made. The latest published map of Holmes River will be found in House Document No. 820, Sixty-third Congress, second session.

Condition at the end of fiscal year.—This project was completed in 1893 and resulted in securing a navigable channel as called for under the project, the main benefits being in the removal of obstructions which had theretofore hindered navigation. At the end of the fiscal year navigation could be carried on without difficulty for the entire length of river covered by the project, except at Boynton Bar, about 3 miles above the mouth, where considerable difficulty is met, the depth of water over this bar being 3 feet, which is the controlling depth for the river. Vessels drawing 3 feet of water can navigate from the mouth to Vernon during the entire year, and 5 feet can ordinarily be carried from October to June, inclusive. There are no gauges established on this river. The total expenditures under the existing project to the end of the fiscal year were \$8,562.05 for new work and \$18,087.39 for maintenance, making a total of \$26,649.44.

Effect of improvement.—There are no railroads through the section supplied by this stream. It is the only means of transportation, other than highroads, for supplying a fairly populous and prosperous community. It is not known whether or not the improvement has had any effect on freight rates.

Proposed operations.—With the funds available at the end of the fiscal year it is proposed to dredge Boynton Bar so as to remove the remaining obstructions in order to secure good navigation on this river. Some snagging operations will be carried on, and surveys and repairs to plant will be made as needed. This work will be done during the months of July to October, inclusive, by the dredge *Choctawhatchee*, operated with hired labor and with a monthly operating expenditure of approximately \$700.

It is estimated that \$1,000 will be needed for the fiscal year 1918, the funds to be expended for maintenance work, including snagging, surveys, and repairs to plant.

Commercial statistics.—The commerce for this stream for the calendar year 1915 was 14,477 short tons, valued at \$787,508, all of which used the improvement. It consisted principally of cotton, fertilizer, grain, manufactured iron and steel, miscellaneous merchandise, naval stores, logs, and crossties. The usual limit of draft for loaded boats is 4 feet.

Comparative statement.

Year.	Short tons.	Value.
1913.....	23,430	\$900,626
1914.....	13,284	691,988
1915.....	14,477	787,508

There is no change in the nature of the commerce resulting from the improvement.

Amount expended on all projects from 1844 to June 30, 1916:

New work.....	\$8,562.05
Maintenance.....	18,087.39

Total.....	26,649.44
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July 1, 1916, balance available.....	3,694.04
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Amount that can be profitably expended in fiscal year ending June

30, 1918, for maintenance of improvement.....	1,000.00
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CHANNEL FROM APALACHICOLA RIVER TO ANDREWS BAY, FLA.

Location and description.—This waterway, partly natural and partly artificial, is approximately 36.5 miles in length and extends from a point 6 miles above the mouth of the Apalachicola River in a northwesterly direction to St. Andrews Bay, Fla. This waterway is tidal, with an average width at the bottom of the canal of 65 feet.

Existing project.—The existing project calls for a canal 5 feet deep and 65 feet wide at the bottom from Apalachicola River to St. Andrews Bay, by way of the natural waterways indicated above. This project was authorized by the river and harbor act approved June 25, 1910, at an estimated cost of \$450,000, with an annual estimated maintenance cost of \$10,000. (See H. Doc. No. 670, 61st Cong., 2d sess.). Dredging was required over a distance of about 30 miles, the depth of cut ranging from 1 foot to 18 feet. The tidal variation is 1.4 feet. The latest published map of this waterway will be found in the Annual Report of the Chief of Engineers for 1915, opposite page 2497.

Condition at the end of fiscal year.—This project was completed in 1915, and resulted in opening an inland channel between Apalachicola River and St. Andrews Bay, Fla., where such channel had not previously existed. This work was done both by contract and by hired labor, the yardage removed being 918,751 and 3,681,222 cubic yards, respectively. During the fiscal year some snags and obstructions have developed and in some places the canal has shoaled, due to caving in and washing of the banks, the controlling depth at the end of the fiscal year being approximately 3½ feet in Lake Wimico. The total amount expended under the existing project up to the end of the fiscal year was \$505,930.01 for new work and \$8,211.57 for maintenance, making a combined total of \$514,141.58.

Effect of improvement.—The effect of this waterway on the commerce of the district has not as yet been very marked, although a boat has been constructed for the trade and is now making regular trips between Apalachicola and various points on St. Andrews Bay. The canal has also, during the latter part of the fiscal year, been

rather extensively used for logging operations. This canal opens up new territory not served by the railroads. It is not known whether or not there has been any marked effect on the freight rates between Apalachicola and St. Andrews Bay.

Proposed operations.—With the funds available at the end of the fiscal year and the funds appropriated by the river and harbor act approved July 27, 1916, it is proposed to remove the snags which have accumulated in the canal, to dredge such places as have shoaled, and to straighten two rather serious bends in the canal, as well as to carry on the necessary repairs and make such surveys as may be required, all at a total cost of \$11,000. It is contemplated that this work will be carried on by hired labor, using the U. S. dredge *Blackwater*, operations to begin about August 15, 1916, and to be completed in about two months, at a monthly operating expense for the dredge of \$4,000. This will be maintenance work.

For the fiscal year 1918 it is estimated that \$14,500 will be required to be used for maintenance work as follows: Repairs to plant at an estimated cost of \$7,500, which repairs were made necessary by the work in this canal, but which it has not been practicable to do since its completion; maintaining the canal by dredging, \$6,000, including the operation of the U. S. dredge *Blackwater*, at a monthly cost of \$4,000; snagging, etc., \$1,000.

Commercial statistics.—The commerce for this waterway for the calendar year 1915 was 775 short tons, valued at \$4,588, all of which used the improvement. It consisted of pine logs and lumber. The usual limit of draft of loaded boats is 5 feet.

The canal was not completed until the year 1915, hence no comparative statement can be given. The Callahan Line have placed in operation during the present year a steamer, the *John W. Callahan, Jr.*, which will make two trips per week from Apalachicola through the canal to St. Andrews Bay, Fla. In addition, extensive logging operations have been started on this waterway.

Amount expended on all projects from June 25, 1910, to June 30.

1916:

New work	\$505, 930. 01
Maintenance	8, 211. 57
Total	<u>514, 141. 58</u>

Balance available for fiscal year ending June 30, 1917	11, 028. 42
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	14, 500. 00

CHOCTAWHATCHEE RIVER, FLA. AND ALA.

Location and description.—The Choctawhatchee River rises in the southeast part of the State of Alabama and flows in a southerly direction for a distance of about 200 miles through Alabama and Florida, emptying into the eastern end of Choctawhatchee Bay about 64 miles east of Pensacola Harbor. The outlet from Choctawhatchee Bay is through Santa Rosa Sound and Narrows, which enter this bay approximately 30 miles from the mouth of the Choctawhatchee River. There is also a passage from Choctawhatchee Bay into the Gulf of Mexico through East Pass, which lies just south of the point where the Santa Rosa Sound connects with the bay, but this pass can be used only in fair weather and by small boats.

Existing project.—The existing project provides for the maintenance of a navigable channel at low water from the mouth to Newton, Ala., 140 miles above the mouth, including Cypress Top Outlet. The river and harbor act approved June 23, 1874, adopted the improvement of that portion of the stream between the mouth of the river and Geneva, Ala., at an estimated cost of \$34,332, to cover the removal of Snags, overhanging trees. (See S. Doc. No. 63, 42d Cong., 2d sess.) The river and harbor act approved April 2, 1882, appropriated \$12,000 for work between Geneva and Newton, further confirmed by the river and harbor act of September 19, 1890, which provides for low-water navigation between these two points. No estimate for this modification was made until later, when one of \$57,125 was submitted to obtain a channel 3 feet deep by 60 feet wide by the removal of hard blue-clay obstructions and by rock excavation, together with the removal of snags and overhanging trees. (See Annual Report for 1889, p. 1423.) The river and harbor act of June 13, 1902, modified the project by including Cypress Top Outlet, one of the mouths of the stream. No estimate for maintenance was made for any of the above projects. The latest published map of Choctawhatchee River will be found in House Document No. 688, Sixty-third Congress, second session.

Conditions at the end of fiscal year.—This project was completed in 1906, the result having been to open up the river for navigation in accordance with project plans. At the end of the fiscal year the improvement was in fair condition, although there has been an accumulation of snags and other obstructions which require removal. The controlling depths at the end of the fiscal year at mean low water were 6 feet at the Cypress Top Outlet, 3 feet at a point 32 miles from the mouth, 2 feet at a point 55 miles from the mouth, and 1.5 feet at a point 85 miles from the mouth. Boats drawing the above can use the stream to the points indicated throughout the year, and from October to June 5 feet can be carried to Caryville, 67 miles from the mouth; 4 feet to Geneva, 96 miles; and 3 feet to Newton, 140 miles. There is a gauge established on this river at Caryville with its zero at extreme low water. The total expenditures under the existing project up to the end of the fiscal year were \$134,494.02 for new work and \$105,288.13 for maintenance, making a combined total of \$239,782.15.

Effect of improvement.—The effect of the improvement on freight rates was beneficial as long as the improvement was maintained in good condition, and the result of last year's work has been the cause of a revival in the lumber business, new sawmills having been established at several points on the river. In connection with the Holmes River the Choctawhatchee River offers transportation to a large section of Florida without any other facilities except high roads.

Proposed operations.—With the funds on hand at the end of the fiscal year and the funds appropriated by the river and harbor act approved July 27, 1916, it is proposed to carry on snagging operations throughout the entire river at a total cost of \$14,000, from August 15, 1916, until June 30, 1917, using the U. S. snag boats *Escambia*, *Geneva*, and *Conecuh*, at a monthly operating cost of \$2,000, and to dredge at certain shoals between points 55 and 96 miles, respectively, above the mouth at a total cost of \$6,600, during

the period November 1, 1916, to June 30, 1917, using the U. S. dredge *Choctawhatchee* at a monthly operating cost of \$700.

It is estimated that \$6,000 will be required for the fiscal year 1918 for maintenance, including snagging, surveys, and repairs to plant.

Commercial statistics.—The commerce for this river for the calendar year 1915 was 30,466 short tons, valued at \$1,019,627, all of which used the improvement. It consisted principally of cotton, fertilizer, grain, logs, naval stores, crossties, and miscellaneous merchandise. The usual limit of draft for loaded boats is 4 feet.

Comparative statement.

Year.	Short tons.	Value.
1913.....	73,877	\$1,585,969
1914.....	25,440	919,688
1915.....	30,466	1,019,627

There is no change in the nature of the commerce resulting from the improvement.

Amount expended on all projects from 1883 to June 30, 1916:	
New work.....	\$171,884.50
Maintenance.....	105,288.13
Total.....	277,172.63
Balance available for fiscal year ending June 30, 1917.....	
20,910.49	
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	
6,000.00	

ESCAMBIA AND CONECUH RIVERS, FLA. AND ALA.

Location and description.—These two names apply to a single stream rising in central Alabama below Union Springs and flowing in a southwesterly direction to the Florida State line, thence southerly through Florida to Escambia Bay, an arm of Pensacola Bay. In the State of Alabama the stream is approximately 235 miles long and is known as Conecuh River, and in Florida it is 65½ miles long and is known as Escambia River.

Existing project.—The existing project provides for a channel 150 feet wide and 5½ feet deep at mean low water through the bar at the mouth of the river, to be extended by a navigable channel from the mouth of the river to Patsaliga Creek, a distance of 147 miles. That portion of the project, including the channel at the mouth of the Escambia River, was adopted by the river and harbor act of June 14, 1880. (See Annual Report for 1879, p. 852.) The channel at the mouth of the river was to be obtained by dredging and the remainder of the work was to consist of the removal of certain obstructions to navigation and the construction of dikes, wing dams, and shore protection to obtain 5 feet to the Florida State line, at an estimated cost of \$25,000. That portion of the project relating to the Conecuh River was authorized by the act of Congress approved March 2, 1907 (see H. Doc. No. 159, 59th Cong., 1st sess.), at an estimated cost of \$31,000, the work to consist of removal of snags, closing cut-offs, and constructing wing dams. No estimate for maintenance was made. This project called for a channel to be dredged

across the bar at the mouth of the river 2,200 feet long. Jetties and wing dams are of the usual pile and brush type. The only published map of this river will be found in House Document No. 701, Sixty-third Congress, second session.

Condition at the end of fiscal year.—This project was apparently completed about 1882, although the reports are not definite as to just what year the final work was done. The result of the improvement was the development of a channel 150 feet wide and $5\frac{1}{2}$ feet deep through the bar at the mouth of the river, and a navigable channel from the mouth of the river to Patsaliga Creek, as called for in the existing project. At the end of the fiscal year the bar at the mouth of the river had shoaled to a minimum depth of about 4 feet, and snags and other obstructions had accumulated in the river so that the controlling depth to Patsaliga Creek, aside from the bar at the mouth of the river, was approximately 6 feet to Molino, 3 feet to the State line, and 1.5 feet beyond. There is little navigation on this river, except for log rafts. Drafts as above can be carried throughout the year. High-water navigation, with drafts up to 4 feet, can be ordinarily depended on from December to March. There are no gauges on this river. The total expenditures under the existing project up to the end of the fiscal year were \$47,161.26 for new work and \$74,867.61 for maintenance, making a combined total of \$122,028.87. The project was completed for \$8,838.74 less than the original estimate.

Effect of improvement.—The general effect of the improvement was to admit of safe transportation of timber in rafts on a stage of water approximately 3 feet less than under original conditions. This improvement has had no effect on freight rates.

Proposed operations.—No operations on this improvement are proposed for the fiscal year 1917.

It is estimated that \$2,500 will be needed for the fiscal year 1918 to be used in dredging a channel across the bar at the mouth of the river, which bar has shoaled to such an extent as to render it difficult and dangerous for tugs to enter the mouth of the river in order to take barges of timber in tow. Regulations, issued by the War Department, prohibit the rafting of certain-sized timber beyond the mouth of tributaries to Pensacola Harbor, thus rendering it imperative that such timber should be placed upon barges before going over the bar. This estimate includes the operating cost of the dredge *Blackwater* at a monthly cost of \$2,500.

The average maintenance cost for the years 1914, 1915, and 1916 has been \$2,463, which is practically the same as that asked for above.

Commercial statistics.—The commerce for this stream for the calendar year 1915 was 85,000 short tons, valued at \$850,000, all of which used the improvement. It consisted entirely of pine lumber and timber. The usual limit of draft was 5 feet for the lumber and 1.5 feet for the timber, the latter forming about four-fifths of the tonnage.

Comparative statement.

Year.	Short tons.	Value.
1913.....	107,713	\$1,026,880
1914.....	70,912	709,120
1915.....	85,000	850,000

There is no change in the nature of the commerce resulting from the improvement.

Amount expended on all projects from 1833, to June 30, 1916:

New work	\$118, 336. 26
Maintenance	74, 867. 61
Total	193, 203. 87
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	2, 500. 00

MOBILE HARBOR, ALA.

Location and description.—This harbor is in the southwestern part of the State of Alabama, about 92 miles from Pensacola, Fla., on the east, and about 61 miles from Pascagoula, Miss., on the west.

Existing project.—This provides for the formation of a channel 300 feet wide in Mobile River and 200 feet wide in Mobile Bay with a depth of 27 feet at mean low water. The average range of the tide at the upper end of this channel is about 1.4 feet and at its lower end about 1.1 feet. The dredged channel extends from Chickasaw Creek, about 5 miles above the mouth of Mobile River, to deep water in the lower part of Mobile Bay, a distance of $33\frac{1}{2}$ miles. The estimated cost of original work under this project is \$1,802,548, and its maintenance \$100,000 per annum. This project was adopted by the river and harbor act approved June 25, 1910. (See H. Doc. No. 657, 61st Cong., 2d sess.) The act of June 13, 1902, made the removal of sunken obstructions part of the maintenance of Mobile Harbor. The latest published map of this locality may be found on page 1916 of the Annual Report for 1912.

Condition at the end of fiscal year.—The existing project has been completed. Expenditures since its completion have been applied to maintenance of the existing project. An increase in depth of $21\frac{1}{2}$ feet over that originally existing has resulted. On June 30, 1916, the controlling depth in the dredged channel was 26.8 feet at mean low water. The total expenditures under the existing project to June 30, 1916, are as follows: For new work, \$1,479,126.70, and for maintenance, \$395,265.65 (including \$25,885.76 for removing sunken obstructions), a total of \$1,874,392.35. The project was completed during the fiscal year ending June 30, 1915. The cost of its completion, including \$144,363.45 for maintenance dredging during its progress, was \$179,057.85 less than the approved estimate of \$1,802,548.

Local cooperation.—No conditions were imposed by law. The city of Mobile has expended the following amounts in the construction of a public wharf, a bulkhead, a steel shed, and in dredging necessary to produce 27 feet of water between its wharf and the United States dredged channel: Cost of wharf and bulkhead and repairs to same, \$29,526; cost of shed and repairs to same, \$61,641; and cost of dredging in front of wharf, \$60,094.

Effect of improvement.—The effect of the improvement has been to give Mobile a reduction in rail freight rates between this port and Atlantic seaports and, by admitting a larger class of steamers, to reduce insurance and water freight rates upon shipments between Mobile and other ports.

Proposed operations.—It is proposed to use the funds available on July 1, 1916, \$15,993.96, and the \$135,000 appropriated by the river and harbor act of July 27, 1916, as follows:

Operation of one hydraulic pipe-line dredge one year in maintaining the improvement, including upkeep of plant, surveys and office expenses, and contingencies-----	\$112, 205. 75
Construction of about 1,200 feet of floating pipe line (estimated time, 8 months)-----	25, 000. 00
Construction of residence for caretaker on Pinto Pass Reservation (estimated time, 2 months)-----	1, 500. 00
Removing obstructions from Mobile Harbor by day labor with United States plant (estimated time, 8 months)-----	12, 288. 21
Total -----	150,993. 96

It is estimated that the above funds will be exhausted by June 30, 1917.

The dredged channel shoals at the rate of about 4,910,000 cubic yards per annum. Snags, logs, and sunken obstructions accumulate in the river channel. The maintenance of the dredged channel requires the attention of a hydraulic pipe-line dredge all the time, and the services of a snag boat a considerable portion of the time. With funds estimated for the fiscal year ending June 30, 1918, it is proposed to do the following work:

Operation of one hydraulic pipe-line dredge one year in maintaining the improvement, including upkeep of plant, surveys, and office expenses -----	\$105,000
Operation of one snag boat three months, including upkeep and care of plant and office expenses-----	5, 000
Total-----	110, 000

Commercial statistics.—The total commerce for Mobile Harbor during the past three years, including bunker coal and river shipments, is given below:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	2, 212, 805	\$61, 368, 688
1914.....	2, 392, 442	58, 085, 903
1915.....	1, 579, 804	46, 440, 771

Amount expended on all projects from May 20, 1826, to June 30, 1916:

New work-----	\$6, 298, 785. 81
Maintenance-----	1, 121, 097. 72
Total -----	7, 419, 883. 53

Balance available for fiscal year ending June 30, 1917-----	150, 993. 96
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	110, 000. 00

MOBILE HARBOR, ALA.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1763, Sixty-fourth Congress, second session:

Mobile Harbor ship channel extends from Chickasaw Creek to deep water in lower Mobile Bay, a distance of about 33½ miles. From the lower end of this channel to Mobile Bar, a distance of about 6 miles, there is a natural depth of

30 feet or more, with a width of from 1,000 feet to more than 2,500 feet. The existing project for improvement of Mobile Harbor, adopted by the river and harbor act of June 25, 1910, provides for a channel of 27 feet deep at mean low water, 300 feet wide in Mobile River and 200 feet wide in Mobile Bay. To June 30, 1915, the total expenditures on all projects for the harbor amounted to \$7,322,362.33. The existing and only project for improvement of Mobile Bar was adopted by the act of June 13, 1902, and provides for a channel 300 feet wide and 30 feet deep at mean low water. Expenditures on this project to June 30, 1915, amounted to \$241,739.20. All original work at the harbor and bar has been completed, and present operations consist of maintenance. The district officer submits estimates for channels in Mobile Harbor 27 feet and 30 feet deep and 300 feet wide, both by way of the present route and by way of a new route along the western side of the bay. Estimates are also submitted for channels 33 and 35 feet deep and 450 feet wide over the bar. He believes that a channel across the bar 33 feet deep and 450 feet wide, at an estimated cost of \$62,200, and a channel in the bay and river in the present location 30 feet deep and 300 feet wide at the bottom, at an estimated cost of \$1,030,000, are justified by the extent of the commercial interests involved, and he recommends that channels of these dimensions be adopted, provided that no work be done until local authorities have made provision for the establishment of additional transfer and terminal facilities. It is proposed to do the work by existing Government plant, augmented by one additional dredge, the cost of which is included in the above estimate for the channel in Mobile Bay and River. The division engineer concurs in the recommendations of the district officer.

The Board of Engineers for Rivers and Harbors concurs in the views of the district officer and division engineer, with a slight modification of the recommended conditions of local cooperation.

I concur generally in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of Mobile Harbor and Bar, Ala., is deemed advisable to the extent of providing a channel over the bar 450 feet wide and 33 feet deep at mean low water, as proposed by the district officer, at an estimated cost of \$62,200 and \$15,000 annually for maintenance; and a channel in the bay and river 300 feet wide and 30 feet deep at mean low water, following the present location, at an estimated cost of \$1,030,000 and \$150,000 annually for maintenance, provided that no work be done under the new project until local interests have established pilotage dues and port regulations satisfactory to the Secretary of War, have submitted acceptable plans for development of adequate terminal facilities, and have given assurance satisfactory to the Secretary of War that these terminal facilities will be provided within a reasonable time.

ALABAMA RIVER, ALA.

Location and description.—The Alabama River is formed 22½ miles above Montgomery, Ala., by the junction of the Coosa and Tallapoosa Rivers. From this junction it flows in a southwesterly direction through the State of Alabama for a distance of 315½ miles and unites about 44 miles north of the city of Mobile, in the southwestern part of the State, with the Tombigbee River to form the Mobile River.

Existing project.—The existing project provides for securing a channel by open-channel work not less than 4 feet deep from Wetumpka, Ala., on the Coosa River 11 miles above its junction with the Tallapoosa River to the mouth of the Alabama River. That portion of the project included between Montgomery and the mouth of the river, a distance of 293 miles, was authorized by the river and harbor act of March 3, 1905, which appropriated \$100,000 for improvement and maintenance, with a view to obtaining as nearly as possible a channel of depth not less than 4 feet by open-channel work. This act also called for a preliminary examination with a view to securing continuous navigation from the mouth to Montgomery and

from Montgomery to Wetumpka. As a result of this examination an estimate of \$650,000 for improvement and \$50,000 for annual maintenance was made for securing a 4-foot channel from Montgomery to the mouth. See H. Doc. No. 378, 59th Cong., 1st sess.) The part of the project from Montgomery to Wetumpka, a distance of 28.6 miles, was authorized by the river and harbor act of June 25, 1910 (see H. Doc. No. 1089, 60th Cong., 2d sess.), at an estimated cost of \$36,000, with an annual maintenance cost of \$5,000. Under this project dredging and contraction works were required at various obstructing shoals, usually consisting of gravel bars distributed over a length of river about 300 miles long. The latest published map of Alabama River will be found in the Annual Report for 1913, page 2124.

Condition at end of fiscal year.—At the end of the fiscal year the existing project was 78 per cent completed. As a result of the improvement navigation is practicable from the mouth of the river to Montgomery, Ala., for the entire year for boats not exceeding 3 feet in draft, except for unusually low stages of the water. Practically no work has been done under the new project between Montgomery and Wetumpka, Ala. The controlling depth at the end of the fiscal year at extreme low water, occurring at rare intervals only, was about 2 feet at Youngs Bar and Gardners Island. Boats drawing 3 feet or less can usually operate throughout the year. Boats requiring more than 3 feet can operate on the river between the months of December to June, inclusive. Gauges are established at Montgomery and Selma, the readings on these two gauges for extreme low water being minus 2 feet. The work still remaining to be done to complete the project is dredging at various bars between Gardners Island and the mouth of the river (a distance of 230 miles), from which it is estimated that 400,000 cubic yards of material will be removed, and that the construction of approximately 14,000 linear feet of pile and brush jetties and 10,000 linear feet of gravel dams will be necessary from Montgomery to the mouth. At the end of the fiscal year the work already done was in only fair condition, as many of the pile and brush dikes and spur jetties will have to be repaired and renewed, and maintenance dredging will have to be carried on at several places. The total expenditure under the existing project up to the end of the fiscal year was \$450,787.32 for new work and \$406,312.04 for maintenance, making a total of \$857,099.36.

Local cooperation.—The city of Montgomery has established an incline, which greatly facilitates the loading and unloading of boats at that city. At Selma, Ala., there is a free inclined road, on which freight is hauled by teams.

Effect of improvement.—The effect of the improvement has been to maintain on the river effective competition with the railroads as far as Selma, and to some extent to Montgomery. Whether this competition has resulted in an actual lowering of rates is not known, but it is claimed that the competition has prevented an increase in rates. There has been a revival in the river traffic during the past year and it is anticipated that greater use will be made of this means of transportation in the future than has been made in the past.

Proposed operations.—With the funds appropriated by the river and harbor act approved July 27, 1916, continuation of work of

improvement is contemplated as follows: Dredging at Gardners Island, Travers Crossing, Cunningham Bluff, Fishtrap Bar, Fishtrap Lower Bar, and Youngs Bar from September 15, 1916, to December 31, 1916, at a cost of \$17,000, using the U. S. towboat *Alabama* and the U. S. dredge *Pettus*, with hired labor, at a monthly operating cost of \$4,500; jetty work, consisting of pile and brush jetties, stone-paved gravel jetties, and submerged dams at Hadnots Bar, Lower Catoma Bar, O'Possum Bight, Manack Bar, Tallawassee Bar, Cypress Creek, Holy Ground Bar, Benton Bar, Gardners Island, Cunningham Bluff, and Fishtrap Bar, at a total cost of \$41,000, using hired labor and the U. S. towboat *Alabama* and the U. S. dredge *Pettus* and auxiliary plant at a monthly operating cost of \$6,500, the work to be done in the periods between August 1, 1916, and September 15, 1916, and between January 1, 1917, to June 30, 1917. Maintenance, snagging, and jetty-repair work will be carried on throughout the entire river where needed, at a total cost of \$7,000, using hired labor and the U. S. snag boat *Wm. J. Twining*, at a monthly operating cost of \$1,200, the work to be done in the periods of September 1, 1916, to December 1, 1916, and May 1, 1917, to June 30, 1917. New plant will be purchased at a cost of \$14,000; minor repairs to existing plant will be made at a cost of \$12,000, and surveys will be carried on and incidental work done at a total cost of \$4,000. It is estimated that there will be \$5,000 unexpended at the end of the fiscal year.

It is estimated that \$85,000, in addition to the \$5,000 above mentioned, will be needed for the fiscal year 1918, to be expended for new work in dredging, at a cost of \$37,000, by hired labor using Government plant, including the U. S. towboat *Alabama* and U. S. dredge *Pettus*, at a monthly cost of \$4,500, and the construction of jetties, submerged dams, and other contraction works, at a cost of \$30,000, by hired labor using Government plant, including the U. S. towboat *Alabama*, U. S. dredge *Pettus*, and auxiliary plant at a monthly cost of \$6,500. Maintenance work will also be done at a cost of \$9,000 by hired labor using Government plant, including operation of U. S. snag boat *Wm. J. Twining*, at a monthly cost of \$1,100. Surveys and minor repairs will be made as needed, the total estimated cost for maintenance being \$23,000.

Commercial statistics.—The commerce for this stream for the calendar year 1915 was 76,417 short tons, valued at \$3,831,064, all of which used the improvement. It consisted principally of cotton, cotton seed, fertilizer, grain, logs, lumber, timber, naval stores, manufactured iron and steel, and miscellaneous merchandise. The usual limit of draft for loaded boats is 6 feet.

Comparative statement.

Year.	Short tons.	Value.
1913.....	153,295	\$6,141,808
1914.....	112,345	4,329,007
1915.....	76,417	3,831,064

There is no change in the nature of the commerce resulting from the improvement. The steamer *American* was destroyed by fire early

in the year 1915. The steamer *Peerless* was built early in the year 1915 and is now operating on the river between Mobile and Montgomery. The decrease in value was due to the unsettled condition of the lumber, timber, cotton, and naval stores market. This decrease is in all probability a temporary one.

Amount expended on all projects from June 18, 1878, to June 30, 1916:

New work-----	\$851, 207. 89
Maintenance -----	425, 337. 16
Total -----	1, 276, 545. 05
Balance available for fiscal year ending June 30, 1917-----	100, 227. 66

Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement-----	62, 000. 00
For maintenance of improvement-----	23, 000. 00
Total -----	85, 000. 00

TOMBIGBEE RIVER, ALA., FROM MOUTH TO DEMOPOLIS (MAINTENANCE OF CHANNEL.)

Location and description.—The source of this river is in northeastern Mississippi, and its mouth at the point where, by confluence with the Alabama, it forms the Mobile River, 45 miles from Mobile Bay. Its length is about 503 miles, its flow southerly, and the length of this section, from mouth to Demopolis, is 185 miles. The section is tidal for a distance of 66 miles above its mouth, above which point it is canalized.

Existing project.—The existing project for the improvement of the Tombigbee River from the mouth to Demopolis, a distance of 185 miles, adopted by the river and harbor act of June 13, 1902, contemplated only the maintenance of the existing channel by the removal of logs, snags, and other obstructions from the stream and by the repair of dikes. This project, as well as that for lock and dam construction, is based on a survey, report of which is dated December 24, 1889. (See Annual Report for 1890, p. 1719, and H. Doc. No. 156, 51st Cong., 1st sess.) The document contains no maps. The tidal variation is about 1 foot at mouth.

Conditions at the end of fiscal year.—The project is for maintenance only. Since the completion of the canalization, which includes the part of this section above Lock 1, for which see preceding report on Black Warrior, Warrior, and Tombigbee Rivers, Ala., the general condition is much improved, and, although the channel is narrow and tortuous in places, a 6-foot draft for all-year navigation obtains throughout this section. At the end of the fiscal year the channel was clear of all obstructions. The total expenditures under the existing project up to the end of the fiscal year were \$144,526.31, all for maintenance.

Effect of improvement.—The effect of the project has been to render navigation safer and cause a probable reduction to an unknown extent of freight rates between Mobile and points on the river below Demopolis. Large quantities of low-class freight contiguous to the river have been transported, which could not have been profitably marketed except for river improvement.

Proposed operations.—It is estimated that the construction of derrick boat and of hull for 10-inch dredge and the necessary work of maintenance to June 30, 1918, will cost about \$74,000, thus requiring an additional appropriation of \$30,000, and an estimate for this sum is submitted.

Commercial statistics.—Commerce on this section, consisting principally of logs, lumber, cotton, fertilizer, staves, coal, and general merchandise, for the calendar years 1913, 1914, and 1915 is as follows:

Comparative statement.

Year.	Short tons.	Value.
1913.....	178,718	\$3,139,551
1914.....	299,975	2,712,351
1915.....	260,092	3,060,052

Amount expended on all projects from 1871 to June 30, 1916:

New work.....	\$199,542.48
Maintenance	194,526.31

Total	394,068.79
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Balance available for fiscal year ending June 30, 1917.....	44,000.00
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	30,000.00
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TOMBIGBEE RIVER, FROM DEMOPOLIS, ALA., TO WALKERS BRIDGE, MISS.

Location and description.—The source of the river is in northeastern Mississippi, its flow southeasterly, and its mouth 45 miles from Mobile, Ala., where it unites with the Alabama to form the Mobile River. From Demopolis, the lower limit of the improvement, to the mouth is 185 miles.

Existing project.—The present project for the section from Demopolis to Columbus, 149 miles, was adopted by river and harbor act of September 19, 1890, and provides for securing a channel 6 feet deep at low water by snagging, tree cutting, bank revetment, bar improvement, and the construction of locks and dams at an original cost of \$779,400 and \$28,500 for maintenance annually.

The present project, as adopted by river and harbor acts of March 3, 1873, and August 11, 1888, for the section of 169 miles from Columbus to Walkers Bridge, provides for securing a high-water channel by the removal of obstructions at an estimated cost of \$47,000 and \$6,500 annually for maintenance. This part of the improvement was formerly divided into two sections, but later appropriations were made for the work as one improvement. Since 1911 work has been restricted to improvement at and below Aberdeen. The river and harbor act of February 27, 1911, consolidated the improvement from Demopolis to Walkers Bridge under one head and made one appropriation for this section.

Condition at the end of fiscal year.—The proportion of the approved project accomplished from Demopolis to Columbus can not be stated. Since 1902, expenditures have been applied to maintenance under existing projects for this entire section. Navigation

above Aberdeen, Miss., for a distance of 119 miles is impracticable except for rafting at the mean and high stages. From Aberdeen to Columbus, about 50 miles, navigation is possible at high stages but dangerous on account of rapid fluctuation, and no boats ply this part of the section. From Columbus to Demopolis, 149 miles, navigation at mean and high stages, during about four months each year, is comparatively safe for river steamers with a draft of 5 feet, but boats rarely go up as far as Columbus—Pickensville, 114 miles above Demopolis, usually being the upper limit. At low water navigation is mostly confined to small craft except for a few miles above Demopolis, the controlling depth being about one foot. The total expenditures under the existing project are \$150,307.73 for improvement and \$175,877.36 for maintenance, a total of \$326,185.09.

Effect of improvement.—The effect has been to render water transportation safer and to result in lower freight rates between Mobile and points on the Tombigbee River above Demopolis, the exact effect being difficult to estimate.

Proposed operations.—It is proposed to use the funds available on July 1, 1916, \$750, and the \$10,000 appropriated by the river and harbor act of July 27, 1916, as follows:

Operation of one United States snag boat.....	\$8, 000
Repair and upkeep of plant.....	1, 250
Office and contingencies.....	1, 500
Total.....	10, 750

The above funds will be exhausted by January 31, 1917.

With the estimate of \$15,000 submitted for the prosecution of work in this section during the fiscal year ending June 30, 1918, it is proposed to operate one United States snag boat in removing snags and other obstructions from the channels and banks of this section of river, between Demopolis and Columbus, all work being for maintenance.

Commercial statistics.—The traffic over this section of river for the calendar years 1913, 1914, and 1915 is as follows:

Comparative statement.

Year.	Short tons.	Value.
1913.....	64, 523	\$876, 672. 00
1914.....	29, 096	495, 140. 00
1915.....	34, 233	461, 752. 60

The principal commodities for the current year consisted of cotton, cotton seed, fertilizer, hardware, logs, staves, and miscellaneous.

Amount expended on all projects from 1871 to June 30, 1916:

New work.....	\$197, 650. 71
Maintenance	191, 917. 36
Total	389, 568. 07

Balance available for fiscal year ending June 30, 1917.....	10, 750. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	15, 000. 00

CHANNEL BETWEEN MOBILE BAY AND MISSISSIPPI SOUND, ALA.

Location and description.—This channel is south of the southwestern part of the State of Alabama and affords passage through the shoal water between Mobile Bay and Mississippi Sound. It is about 30 miles south of Mobile, Ala., and about 31 miles east of Pascagoula, Miss.

Existing project.—This project was adopted by the river and harbor act of July 25, 1912, and provides for a channel 100 feet wide at bottom and 10 feet deep at mean low water from curve of 10-foot depth in Mobile Bay to the 8½-foot contour in Mississippi Sound, a distance of about 4 miles, at an estimated cost of \$50,000. (H. Doc. No. 967, 60th Cong., 1st sess., which contains the latest published map.) As the mud is soft in Mississippi Sound, a vessel with a draft of 10 feet can go through it. The average range of the tide is 1.2 feet. The cost of maintaining this improvement has been estimated at \$10,000 per year.

Condition at the end of fiscal year.—A channel 10 feet deep and 100 feet wide at bottom has been dredged through the shoal waters at this locality from the 10-foot contour in Mobile Bay to the 8½-foot contour in Mississippi Sound, a distance of about 4 miles. This channel provides a passageway between Mobile Bay and Mississippi Sound and is protected to some extent by the shoal water through which it extends and by Dauphin Island on the south and the mainland of Alabama on the north. All work on this improvement has consisted of dredging. The existing project has been completed. Expenditures since its completion have been applied to its maintenance. An increase in depth of 7 feet over that originally existing has resulted. On June 30, 1916, the controlling depth in the dredged channel was 10.3 feet at mean low water. The total expenditures under the existing project to June 30, 1916, are as follows: For new work, \$45,604.59, and for maintenance, \$3,895.41; a total of \$49,500. The project was completed during the fiscal year 1915 for \$4,395.41 less than the original estimate.

Effect of improvement.—The project results in effecting a saving in freight rates between Mobile, Ala., and New Orleans, La., and intermediate points on the Mississippi coast. A channel 3 or 4 feet deeper than formerly is now available, and vessels no longer pay the toll charged them when passing through Grants Pass.

Proposed operations.—It is proposed to use the funds available on July 1, 1916—\$490—and the \$5,000 appropriated by the river and harbor act of July 27, 1916, as follows: Operation of one hydraulic pipeline dredge one-half month, including upkeep of plant, surveys, and office expenses, \$5,490.

It is estimated that the above amount will be exhausted by June 30, 1917.

The dredged channel shoals at the rate of 100,000 cubic yards per annum. It was last redredged in March and April, 1916.

With funds estimated for the fiscal year ending June 30, 1918, it is proposed to do the following work: Operation of one hydraulic pipe-line dredge one-half month, including care and upkeep of plant, surveys, and office expenses, \$5,000.

Commercial statistics.—The total commerce for the channel between Mobile Bay and Mississippi Sound during the last three years is given below:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	81,076	\$551,591
1914.....	51,098	423,638
1915.....	82,744	998,947

The commerce during 1915 consisted principally of fish and oysters, general merchandise, naval stores, cotton and cotton products, coal, lumber, stone, and sand and gravel.

Amount expended on all projects from May 23, 1828, to June 30, 1916:

New work.....	\$45,604.59
Maintenance.....	3,895.41

Total	49,500.00
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Balance available for fiscal year ending June 30, 1917.....	5,490.00
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	5,000.00
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PASCAGOULA HARBOR, MISS.

Location and description.—This harbor is in southeastern Mississippi, about 61 miles from Mobile, Ala., on the east, and about 44 miles from Gulfport, Miss., on the west. It includes the lower 4 miles of Dog River, the lower 6.8 miles of Pascagoula River, and a channel across Mississippi Sound and the outer bar at Horn Island, a total distance of 22.7 miles.

Existing project.—This project is a modification of that recommended in the report on the survey of Pascagoula River published in House Document No. 682, Sixty-second Congress, second session, for a channel 22 feet deep at mean low water and 150 feet wide, from the Louisville & Nashville Railroad bridge across the Pascagoula River at Pascagoula, Miss., to a point 4 miles above the mouth of Dog River, and 22 feet deep at mean low water, and 225 feet wide from this bridge across Mississippi Sound to Horn Island Pass, and 25 feet at mean low water and 300 feet wide across the outer bar, at an estimated cost of \$383,000, with \$50,000 annually for maintenance. In acting on this survey the Chief of Engineers recommended approval, provided that \$100,000 be contributed by local interests and that space be provided for suitable wharves furnished both by Moss Point and Pascagoula. As thus modified the project was adopted in the river and harbor act approved March 4, 1913, but under resolution adopted by the Committee on Rivers and Harbors of the House of Representatives on August 15, 1914, before any work had been done, this amended project was examined and modified. As shown in Rivers and Harbors Committee Document No. 12, Sixty-third Congress, second session, the project was further amended by waiving the requirement that as a condition precedent to further improvement a contribution of \$100,000 be made jointly by Moss Point and

Pascagoula, and by limiting the authorized first cost to \$283,000, to be expended in securing a through channel of such dimensions as might be obtained by the expenditure of \$283,000. This sum was the originally estimated cost to the United States of the work included in the so-called 22-foot project of House Document No. 682, Sixty-second Congress, second session. As thus amended, the project was adopted by the river and harbor act approved March 4, 1915, and provides for securing such additional depth in the river, sound, and pass in excess of the previous project depths of 17 feet in the river and sound and 21 feet in the pass, as can be secured by the expenditure of \$283,000. The estimated cost of maintenance is not definitely stated in the project document, but is not expected to exceed \$50,000 a year. The average range of the tide is about $1\frac{3}{4}$ feet. The latest published map of this locality may be found in House Document No. 211, Fifty-fourth Congress, second session.

Condition at the end of fiscal year.—All work under this improvement has consisted of dredging. The 21-foot Horn Island Pass project was completed during the fiscal year ending June 30, 1908, and the 17-foot project for the river and sound was completed to within 85 per cent of its original estimated dimensions in the fiscal year ending June 30, 1911. No new work has been done under the existing project, the expenditures (\$20,716.67) being applied to the maintenance of channels formed under the previous project. On June 30, 1916, there was a controlling depth of 21 feet in the channel across the bar, but, due to rapid shoaling, the controlling depth in the Pascagoula Channel was only 15.6 feet, being an increase over that originally existing of 12.6 feet. The Horn Island Pass Channel affords an increase of 3 feet over that originally existing at that locality.

Local cooperation.—The river and harbor act of March 4, 1915, required local interests to furnish space for public wharves, both at Moss Point and at Pascagoula, 800 feet in length and of such width as may be satisfactory to the Secretary of War. Both towns have provided sites, which were approved by the Secretary of War on May 8, 1916. A small municipal wharf has been built at Pascagoula, Miss., by the town of Pascagoula, at a cost of \$300.

Effect of improvement.—The completion and maintenance of previous projects has resulted in the reduction of rail freight rates between this harbor and seaboard cities on the Atlantic coast, and also in affording direct water freight rates on lumber to other ports.

Proposed operations.—It is proposed to use the funds available on July 1, 1916, \$13,747.24, and the \$80,000 appropriated by the river and harbor act of July 27, 1916, as follows:

Operation of one hydraulic pipe-line dredge about 8 months in new work and maintenance, including upkeep of plant, surveys, office expenses, and contingencies-----	\$83, 747. 24
Operation of one seagoing dredge about 2 months in new and maintenance work, including upkeep of plant, surveys, and office expenses-----	6, 000. 00
Construction of a suitable launch to attend the dredge-----	4, 000. 00
Total-----	93, 747. 24

It is estimated that the above funds will be exhausted by April 30, 1917.

The dredged channel shoals at the rate of about 800,000 cubic yards per annum. Work under the existing project should be commenced. With funds estimated for the fiscal year ending June 30, 1918, it is proposed to do the following work:

Operation of one hydraulic pipe-line dredge about 4 months in maintaining the 17-foot channel through Dog and Pascagoula Rivers and Mississippi Sound, including upkeep of plant, surveys, and office expenses -----	\$32, 000
Operation of one hydraulic pipe-line dredge about 8 months in new work, including upkeep of plant, surveys, and office expenses -----	68, 000
Operation of one seagoing dredge about 1 month in maintaining the 21-foot channel across Horn Island bar, including upkeep of plant, surveys, and office expenses -----	3, 000
Operation of one seagoing dredge 3 months in new work under the existing project, including upkeep of plant, surveys, and office expenses -----	10, 000
Total -----	113, 000

Commercial statistics.—The total commerce for Pascagoula Harbor during the past three years is given below:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	1, 020, 938	\$7, 064, 738
1914.....	604, 569	4, 557, 484
1915.....	102, 851	910, 570

The commerce during 1915 consisted principally of lumber and timber, naval stores, general merchandise, fish and oysters, crossties, wood slabs, and charcoal.

Amount expended on all projects from Mar. 2, 1827, to June 30, 1916:

New work -----	\$904, 441. 61
Maintenance -----	413, 687. 67
Total -----	1, 318, 129. 28
Balance available for fiscal year ending June 30, 1917 -----	93, 747. 24
Amount (estimated) required to be appropriated for completion of existing project -----	¹ 234, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918:	
For works of improvement -----	78, 000. 00
For maintenance of improvement -----	35, 000. 00
Total -----	113, 000 .00

GULFPORT HARBOR AND SHIP ISLAND PASS, MISS.

Location and description.—This improvement is in the southeastern part of the State of Mississippi, about 44 miles from Pascagoula, Miss., on the east and about 78 miles from New Orleans (via Lake Borgne Canal) on the west. The anchorage basin and channel at

¹ Of the \$80,000 appropriated by the river and harbor act of July 27, 1916, it is expected that only \$49,000 will be applied toward work on the new project, the remainder to be expended for maintenance.

Gulfport and the channel across Ship Island Bar have been formed by dredging. The anchorage basin, which is 1,320 by 2,640 feet, is partially surrounded by a wall or revetment. The original project width of the Gulfport Channel was 300 feet. The project depth of the channel and basin was 19 feet at mean low water, but recent shoaling has occurred, and the present controlling depth is only 12.5 feet at mean low water in the channel. The dredged channel is about 7 miles long. The channel through Ship Island Bar has a width of 300 feet and a depth of 22.6 feet at mean low water and is in an exposed locality, being seaward of Ship Island. The basin and channel at Gulfport are not at the mouth of any stream and are in an exposed locality, unprotected by islands or any indentation of the coast line.

Existing project.—The existing project provides for maintaining the 19-foot depth of the previous project and securing such additional depth as may be obtained by the operation of a Government-owned dredge in the basin at Gulfport and the channel leading therefrom to the anchorage at Ship Island and for securing a channel having a depth of 26 feet at mean low water and a width of 300 feet through Ship Island Pass to the Gulf of Mexico. The average range of the tide is about $1\frac{3}{4}$ feet.

The project for the Gulfport Basin and Channel was adopted by the river and harbor act approved February 27, 1911, in accordance with the report printed in Rivers and Harbors Committee Document No. 2, Sixtieth Congress, first session, which contemplates the purchase or construction of a dredge, at a cost of about \$200,000 and \$75,000 annually for its operation.

The project for Ship Island Pass was adopted by the river and harbor act of March 3, 1899, at an estimated cost of \$40,000. (H. Doc. No. 120, 55th Cong., 3d sess.). These two localities were at first improved separately, but were joined in a common project by the river and harbor act of March 2, 1907. The Gulfport Channel is about 7 miles long, the Ship Island Pass Channel about 2 miles long. The latest published map of this improvement may be found on pages 1944 and 1945 of the Annual Report for 1912.

Condition at the end of fiscal year.—All work on this improvement has consisted of dredging and the construction of a bulkhead about 1,400 feet long partially across the seaward end of the anchorage basin to protect it from shoaling. The existing project for Ship Island Pass has been completed, expenditures since being applied to its maintenance. The project depth is an increase of 6 feet over the depth originally existing across Ship Island Bar, but, due to shoals, the controlling depth on June 30, 1916, was only 22.6 feet at mean low water. Due to rapid shoaling, the controlling depth in the Gulfport Harbor Channel and Basin on June 30, 1916, was 12.5 feet at mean low water, an increase of 10 feet over that originally existing. On account of the indefinite nature of the Gulfport Harbor project the percentage of completion can not be stated. Available funds for Ship Island Pass and those allotted in the future will be applied to the maintenance of the dredged channel. The total expenditures under the existing project to June 30, 1916, are as follows: Gulfport Harbor, for new work, \$20,000, and for maintenance, \$442,717.53, a total of \$462,717.53; Ship Island Pass, for new work, \$39,695.88, and for maintenance, \$58,145.83; a total for both of

\$560,559.24. The Ship Island Pass project was completed during the fiscal year ending June 30, 1900. The cost of its completion was \$304.12 less than the approved estimate of \$40,000. The bulkhead protecting the Gulfport Basin was constructed during the fiscal year ending June 30, 1911. Storms have carried away small portions of this bulkhead in various places, but it still furnishes considerable protection to the basin.

Local cooperation.—There has been none. The Gulf & Ship Island Railroad Co., however, expended about \$1,603,594.53 for the formation and maintenance by dredging of the Gulfport Channel and anchorage basin and received from the United States the contract price of \$150,000. As Gulfport is its terminus and it owns all the piers and wharves and the land and approaches on both sides of the basin, this company is the principal beneficiary, not only of this part of the improvement but also of that at Ship Island Pass. At least 75 per cent of the exports are carried by this road.

Effect of improvement.—The project results in affording a reduction in rail freight rates between Gulfport and seaboard cities of the Atlantic coast and in affording water freight rates from points on the Gulf & Ship Island Railroad to foreign ports.

Proposed operations.—It is proposed to use the funds available on July 1, 1916, \$16,577.29, and the \$85,000 appropriated by the river and harbor act of July 27, 1916, as follows:

Operation of one hydraulic pipe-line dredge about 8 months, in maintaining and improving the channel and basin, including upkeep of plat, surveys, office expenses, and contingencies-----	\$86, 223. 12
Operation of one seagoing dredge about 4 months, in maintaining the channel through Ship Island Bar, including care and upkeep of plant, surveys, and office expenses-----	15, 354. 17
Total -----	101, 577. 29

It is estimated that the above funds will be exhausted by April 30, 1917.

The Ship Island Pass Channel shoals at the rate of about 60,000 cubic yards per annum. The Gulfport Harbor Channel and Basin shoal at the rate of about 2,600,000 cubic yards per year. In order to remove all shoals and properly maintain these channels in the fiscal year ending June 30, 1918, an estimate is submitted for additional funds, as follows:

Operation of one seagoing dredge 5 months, including surveys, upkeep and care of plant, and office expenses-----	\$17, 000
Operation of one hydraulic pipe-line dredge 7 months, including surveys, upkeep and repair of plant, and office expenses, in removing shoals -----	63, 000
Total -----	80, 000

Commercial statistics.—The total commerce for Gulfport Harbor during the past three years is given below:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	611, 982	\$7, 497, 219
1914.....	442, 250	4, 572, 480
1915.....	490, 079	5, 470, 303

The commerce during 1915 consisted principally of lumber and timber, naval stores, general merchandise, cotton, phosphate rock, iron pyrites, and asphaltum.

Amount expended on all projects, March 3, 1899, to June 30, 1916:

New work-----	\$225, 199. 77
Maintenance -----	857, 467. 52
Total-----	<u>1, 083, 667. 29</u>
Balance available for fiscal year ending June 30, 1917-----	101, 577. 29
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement and for maintenance-----	80, 000. 00

PASCAGOULA, LEAF, AND CHICKASAHAY RIVERS, MISS.

Location and description.—The Leaf and Chickasahay Rivers rise in the eastern central part of Mississippi, form the Pascagoula River at their confluence at Merrill, and the latter empties into Mississippi Sound at Pascagoula. The flow is southerly. The section of the Pascagoula under improvement is 82.1 miles long from the mouth of Dog River, 6.8 miles above the mouth of the Pascagoula River on Mississippi Sound, to the junction of the Leaf and Chickasahay at Merrill, Miss. Leaf River from its mouth to the mouth of Bowie Creek, near Hattiesburg, 78.8 miles, and about 75 miles of the Chickasahay, from its mouth to Bucatunna, are also included in the project.

Existing project.—The existing project for the Pascagoula River was adopted by river and harbor act of August 5, 1886, and provides only for maintenance of the channel by the removal of obstructions from time to time. The river and harbor act of March 3, 1899, made a separate appropriation for this river, limiting the improvement to the section 82.1 miles long above the Dog or Escatawpa River. Since then it has been considered a separate improvement, and appropriations have been made accordingly. Report of the examination on which the project was originally based is printed in Annual Report of the Chief of Engineers for 1879, page 835.

The existing project for the Leaf River was adopted by the river and harbor act of September 19, 1890, and provides for making a channel for high-water navigation by the removal of obstructions and overhanging trees, at an estimated cost of \$25,000, from Bowie Creek to the mouth of the river, a distance of 78.8 miles. For the report of the examination on which this project is based see Annual Report of the Chief of Engineers for 1889, page 1462. No change has been made in this project, all work now being applied to maintenance.

The existing project for the Chickasahay River was adopted by the river and harbor act of March 3, 1905, and provides only for maintaining, at an annual cost of \$2,500, the channel in the Chickasahay from the mouth to Bucatunna, Miss., about 75 miles, by the removal of logs, snags, and other obstructions. This project is designed to keep the river in a navigable condition for rafting at high-water stages, and is based on an examination. (See H. Doc. No. 230, 58th Cong., 2d sess., and also Annual Report for 1904, p. 1855.) Tidal variations for the Pascagoula River are about 1½ feet at the mouth.

Conditions at the end of fiscal year.—On the Pascagoula River maximum depths of 7 feet at mean low water from the mouth of Dog River to Dead Lake, 32 miles, and 3 feet above that point, about 50 miles, exists. The channel in places is obstructed by logs and snags. Under the existing project the total expenditure to the end of the fiscal year was \$53,175.04, all for maintenance. The Leaf River is navigable for rafts and logs only at mean and high stages. There is no other navigation. A high-water channel is available for boats of light draft, but navigation is more or less dangerous. The total expenditure under the existing project to the end of the fiscal year was \$40,516.20, of which \$11,019.04 was for improvement and \$29,497.16 for maintenance. The Chickasahay River is navigable for rafts and logs only at mean and high stages, and there is no other commerce. The total expenditures under the existing project to the end of the fiscal year were \$12,850.27, all for maintenance. The total expenditures for the three streams on the existing project have been \$106,541.51, of which \$11,019.04 was for new work and \$95,522.47 for maintenance.

Effect of improvement.—The improvement of the Pascagoula River, besides making navigation safer, is believed to effect a reduction to an unknown extent in freight rates on lumber between Merrill, Miss., and the Gulf coast, but because of the limited commerce the improvement of the Leaf and Chickasahay Rivers has had no apparent effect on freight rates.

Proposed operations.—It is estimated that the necessary work of maintenance to June 30, 1918, will cost about \$22,650, thus requiring an additional appropriation of \$5,000, and an estimate for this sum is submitted.

Commercial statistics.—Commerce on the Pascagoula, Leaf, and Chickasahay Rivers, which consisted principally of logs, lumber, piling, crossties, charcoal, rosin, turpentine, and general merchandise, for the last three calendar years is as follows:

Comparative statement.

River.	Calendar year.	Short tons.	Valuation.
Pascagoula.....	1913	626,956	\$3,939,500
	1914	308,174	2,314,725
	1915	123,690	601,050
Leaf.....	1913	335,010	1,701,000
	1914	179,061	685,746
	1915	114,600	401,200
Chickasahay.....	1913	152,255	446,750
	1914	66,623	254,616
	1915	71,800	168,500

The decrease in commerce for the year 1915 is principally due to depression in the lumber market.

Amount expended on all projects from 1880 to June 30, 1916:

New work	\$38,089.94
Maintenance	95,851.30
Total	133,941.24

Balance available for fiscal year ending June 30, 1917..... 17,650.00

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 5,000.00

EAST PEARL RIVER, MISS.

Location and description.—This improvement is in Lake Borgne, at the entrance to East Pearl River, South of the State of Mississippi and between it and the State of Louisiana. It is about 35 miles west of Gulfport, Miss.

Existing project.—The existing project was adopted by the river and harbor act of June 25, 1910, and provides for the restoration at the mouth of East Pearl River of the former project depth of 9 feet at mean low water over a width of 200 feet, thereby connecting the 9-foot contour in Lake Borgne with the same contour in East Pearl River, a distance of about 1.3 miles. The average range of the tide is $1\frac{3}{4}$ feet. The original work was estimated to cost \$34,000, and the cost of maintenance was estimated at \$6,000 per annum. (See H. Doc. No. 328, 60th Cong., 1st sess.) The latest published map may be found in House Document No. 206, Fifty-fourth Congress, second session.

Condition at the end of fiscal year.—This improvement consists of a dredged channel through the bar at the mouth of this stream, having a depth of 9 feet at mean low water and a width of 200 feet. This channel is about 1.3 miles long and connects the 9-foot curve of depth inside and outside of the bar. All work on this improvement has consisted of dredging. An increase in depth of 2 feet over that originally existing has resulted, but on account of a recently formed shoal the controlling depth on June 30, 1916, in the dredged channel was 7.7 feet at mean low water. The total expenditures under the existing project to June 30, 1916, are as follows: For new work, \$8,928.13; for maintenance, \$10,418.11; a total of \$19,346.24. The project was completed during the fiscal year 1911 for \$25,071.87 less than the approved estimate of \$34,000. The large saving is due to the fact that the original estimate was based on former contract prices at this locality, whereas the work was done by day labor with United States plant.

Effect of improvement.—No change in the nature of the commerce has resulted from the improvement, and the project has had little effect on freight rates. Commerce has been directly benefited, as larger boats can now cross the bar.

Proposed operations.—It is estimated that the necessary work of maintenance to June 30, 1918, will cost about \$11,600, thus requiring an additional appropriation of \$5,000, and an estimate for this sum is submitted.

Commercial statistics.—The total commerce for East Pearl River during the past three years is given below:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	91,925	\$1,068,552
1914.....	113,059	1,106,845
1915.....	85,162	706,775

The commerce during 1915 consisted principally of lumber and timber, oysters, general merchandise, laths and slabs, and bricks.

Amount expended on all projects from July 5, 1884, to June 30, 1916:

New work-----	\$37, 127. 93
Maintenance -----	10, 418. 11
Total -----	47, 546. 04

Balance available for fiscal year ending June 30, 1917----- 6, 634. 76

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement----- 5, 000. 00

YAZOO, TALLAHATCHIE, COLDWATER, AND BIG SUNFLOWER RIVERS, MISS.

Yazoo River and its tributaries were consolidated under one title of appropriation by the river and harbor act of June 13, 1902.

YAZOO RIVER.

Location and description.—This river is formed by the junction of Tallahatchie and Yalobusha Rivers, in Leflore County, Miss., flows about 178 miles in a generally southerly and southwesterly direction, and enters the Mississippi River at Vicksburg, Miss.

Existing project.—This project, which appears to have been based on report printed on page 364 of the Annual Report of the Chief of Engineers for 1874, was adopted by the river and harbor act of March 3, 1875, and contemplates the removal of snags, wrecks, sunken logs, overhanging trees, and other obstructions throughout the entire length of the river, a distance of 178 miles, at an estimated cost of \$120,000 for four years' work. The channel under improvement has an average width of about 500 feet and a minimum depth of 4 feet at all stages during the entire year. A map of the stream was published in the Annual Report for 1913.

Condition at the end of fiscal year.—Nine wrecks of boats sunk during the Civil War, snags, sunken logs, and overhanging trees have been removed, and dredge cuts made through bars, from time to time as funds permitted. This work has kept the channel fairly free from obstructions, so that boats drawing 4 feet can safely navigate the entire river at all stages the year round. During the low-water season, usually from July to December, when the minimum reading on the gauge at Yazoo City is 0 feet, a draft of 4 feet is practicable. During the remainder of the year this gauge reads 6 feet or higher, and boats drawing $4\frac{1}{2}$ feet, which is the largest size vessel using the waterway, have no trouble passing from head to mouth. The expenditure of the estimate was completed in 1888, but new obstructions having formed as old ones were removed, the project for new work imperceptibly changed into maintenance. It is not possible to separate new work from maintenance. The expenditures under the existing project to June 30, 1916, were \$443,304.42, the amounts charged as new work and maintenance not being separable.

Effect of improvement.—The work done under the existing project has made transportation by water easier and safer and has reduced freight rates about $33\frac{1}{3}$ per cent.

Proposed operations.—It is proposed to apply the balance of \$19,217.29 available for the fiscal year ending June 30, 1917, to removing obstructions to navigation throughout the entire length of

the river. This will allow eight months' work of the U. S. snag and dredge boat *Ben Humphreys* at a cost of \$2,000 per month, if the stage of water will permit, which with about \$3,000 for care and repair of the boat after operations are suspended will exhaust the balance by June 30, 1917. Work will begin about September 1, 1916.

The funds for which estimate is submitted are those which experience has shown to be necessary to maintain an unobstructed channel. During the fiscal year ending June 30, 1918, it is proposed to operate the U. S. snag and dredge boat *Ben Humphreys* in removing obstructions from the stream and in making dredge cuts through the bars; to construct a quarter boat, and to employ a chopping party in removing leaning trees along the banks and in destroying obstructions with dynamite. The work of the *Humphreys* is of most importance. Obstructions are continually forming and should be removed if navigation is to be maintained.

Commercial statistics.—All commerce on the river has been directly benefited by its improvement. Boats usually draw about 4 feet loaded. Statistics have been compiled for the fiscal instead of the calendar year because the former more nearly coincides with the commercial year.

Comparative statement.

Fiscal year ending June 30—	Short tons.	Value.
1914.....	100,111	\$1,231,481
1915.....	109,771	2,589,870
1916.....	84,858	3,183,603

The freight carried during the current fiscal year consisted of lumber and logs, farm products, and general merchandise.

Amount expended on all projects from Mar. 3, 1873, to June 30, 1916:	
New work.....	} ¹ \$482,327.48
Maintenance.....	
Balance available for fiscal year ending June 30, 1917.....	19,217.29
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	(²)

TALLAHATCHIE AND COLDWATER RIVERS.

Location and description.—Tallahatchie River rises in Tippah County, Miss., flows about 230 miles in a general southwesterly direction, and joins Yalobusha River in forming Yazoo River at Greenwood. Coldwater River rises in Marshall County, Miss., flows about 125 miles in a general southwesterly direction and empties into the Tallahatchie River in Quitman County, about 115 miles above its mouth.

Existing project.—This project, adopted by the river and harbor act of March 3, 1879, is based on report contained in Senate Executive Document No. 42. Forty-fifth Congress, third session, and contemplates the removal of wrecks, snags, sunken logs, and leaning

¹ Owing to the character of the work it has not been practicable to keep separate the amounts spent for new work and for maintenance.
² See consolidated "Financial summary" following report on Big Sunflower River.

trees between the mouth of Tallahatchie and the mouth of Coldwater River, a distance of 115 miles, and up the latter stream to Yazoo Pass, about 40 miles farther. The estimated cost, if done in two seasons, was \$40,000 for work in Tallahatchie and \$25,000 for the Coldwater. At medium and high stages the channel under improvement in these streams has an average width of about 300 feet, with a depth of 10 feet or more. At low water the minimum depth is about 1 foot. A map of both streams was published in the Annual Report for 1913.

Condition at the end of fiscal year.—Wrecks, snags, sunken logs, and leaning trees have been removed from the portion of the rivers included in the project from time to time as funds were provided, and this work has kept the channel reasonably free from obstructions and has enabled boats drawing 3 feet to run as high as Minter City, 42.4 miles above mouth of Tallahatchie, at all stages the entire year. The principal work has been in the Tallahatchie below Sharkey, 65 miles above the mouth. Nothing was done in the Coldwater between 1881 and 1905. During the low-water season, usually from June to December, when the minimum reading on the gauge at Swan Lake is 0 feet, a draft of $3\frac{1}{2}$ feet is practicable on the Tallahatchie to Minter City, above which a draft of 1 foot only is possible. During the remainder of the year, when this gauge reads 6 feet or higher, boats drawing 4 feet can navigate this section. Because of the tortuous channel boats more than 65 feet long seldom go above Marks. The expenditure of the estimate for the existing project for the Tallahatchie River was completed in 1892, but new obstructions having formed as old ones were removed, the project for new work imperceptibly changed into maintenance. It is not possible to separate new work from maintenance. Since operations in the Coldwater were resumed in 1905 expenditures for its improvement have been so combined with those for the Tallahatchie that it is impossible to make a separate statement of new work or maintenance or state when its project was completed. The expenditures under the existing project to June 30, 1916, were \$136,582.53 on new work and maintenance, the amounts charged to each class of work not being separable.

Effect of improvement.—The work done under the existing project has made transportation by water easier and safer and has reduced freight rates about 30 per cent.

Proposed operations.—It is proposed to apply the balance of \$17,292.20, available for the fiscal year ending June 30, 1917, to the removal of obstructions from the mouth of the Tallahatchie as far upstream as required by commerce within the limits of the project. The work will be done with U. S. derrick boat *No. 116* and a chopping party at a cost of about \$1,500 per month. Operations will begin about September 1, 1916, and continue for about nine months if the stages of water will permit. This work and the care and repair of plant after operations are suspended will exhaust the balance by June 30, 1917.

It is proposed to expend the sum for which estimate is submitted for the fiscal year ending June 30, 1918, to maintaining the improvement by removing obstructions to navigation from Tallahatchie River between its mouth and Sharkey. The work should be

done with U. S. derrick boat *No. 116* and a chopping party on quarter boat *No. 11*. Obstructions are continually forming which should be removed if navigation is to be maintained.

Commercial statistics.—All commerce on these rivers has been directly benefited by their improvement. Boats usually draw about 3 feet loaded. Statistics have been compiled for the fiscal instead of the calendar year, because the former more nearly coincides with the commercial year.

Comparative statement.

Fiscal year ending June 30.	Short tons.	Value.
1914.....	66,695	\$2,434,650
1915.....	22,747	1,672,039
1916.....	59,439	2,311,489

The freight carried during the current fiscal year consisted of lumber and logs, farm products, and general merchandise.

Amount expended on all projects from Mar. 3, 1879, to June 30, 1916:	
New work.....	} ¹ \$136,582.53
Maintenance.....	
Balance available for fiscal year ending June 30, 1917.....	17,292.20
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	(²)

BIG SUNFLOWER RIVER.

Location and description.—This river has its source in Mud Lake, Coahoma County, Miss., flows about 216 miles in a general southerly direction, and enters Yazoo River about 45 miles above its mouth. The stream is alluvial, with stable banks, and carries very little silt or drift.

Existing project.—This project, adopted by the river and harbor act of March 2, 1907, was based on report printed in House Document No. 667, Fifty-ninth Congress, first session, and contemplates the improvement of the river from the mouth to Baird, a distance of 96.1 miles, by the closure of outlets, at an estimated cost of \$75,000, and the construction of contraction works, the removal of snags, sunken logs, leaning trees, and other obstructions, at an estimated cost of \$10,000 per year for five years and \$5,000 per year thereafter. The project was modified by the river and harbor act of July 25, 1912, based on report contained in House Rivers and Harbors Committee Document No. 2, Sixty-second Congress, second session, which added the improvement of the river from Baird to the mouth of the Hushpuckena, a distance of 75.3 miles, by the construction of a lock and dam at the foot of Hollywood Shoals, 74 miles above mouth, at an estimated cost of \$300,000, and open-channel work including

¹ Owing to the character of the work, it has not been practicable to keep separate the amounts spent for new work and for maintenance.
² See consolidated "Financial summary" following report on Big Sunflower River.

dredging and contraction work at an estimated cost of \$50,000. After report of a board of engineers, and by authority of the Secretary of War, the principal features of the lock and dam were fixed as follows:

Number: 1.

Location: Little Callao Landing, Miss.

Above mouth of river: 62.9 miles.

Length between miter sills of locks: 182 feet.

Clear width of lock: 36 feet.

Lift at low water: 16.9 feet.

Available depth on miter sills at low water: 5.1 feet.

Character of foundation: Piling in sand.

Kind of dam: Movable, Poiree, needle.

Type of construction: Concrete, wooden miter gates.

Estimated cost: \$500,000.

The project proposes to obtain a channel at low water from the mouth of Big Sunflower River to the mouth of the Hushpuckena, a distance of 171.4 miles, with an average width of about 100 feet and a least available depth of $4\frac{1}{2}$ feet.

Condition at the end of fiscal year.—The work accomplished has consisted of removing snags, sunken logs, and leaning timber throughout the section included in the project, closing outlets which depleted the stream, and building wing dams to scour a channel through the bars where necessary. The lock and dam at Little Callao Landing is 97 per cent completed. During the low-water season, usually from July to December, when the minimum reading on the gauge at Holly Bluff, Miss., is 55.3 feet, with the aid of the pool formed by fixed part of the dam, a draft of 3 feet is practicable from the mouth of the river to the mouth of Quiver River. During the remainder of the year, when the gauge at Baird, Miss., reads 90 feet or higher, boats drawing 4 feet can navigate the river from the mouth to Sunflower City. The work remaining to complete the project consists of the completion of the lock and dam and the open-channel work between mouth of the river and Eighteen Mile Island (13 miles), Holly Bluff and Choctaw Shoals (11 miles), and from Jones Bayou to Hushpuckena River (48 miles). The expenditures under the existing project to June 30, 1916, were \$515,956.66, of which \$155,355.44 was applied to new work and maintenance which can not be separated, and \$360,601.22 to lock and dam construction.

Effect of improvement.—The work accomplished has made transportation by water easier and safer and has reduced freight rates about $33\frac{1}{3}$ per cent.

Proposed operations.—It is proposed to apply the balance of \$15,922,76 available for the fiscal year ending June 30, 1917, for maintenance of the improvement where needed for removal of obstructions and dredging shoals within the limits of the project. This work will be done by U. S. derrick boat *No. 1* at a cost of about \$1,500 per month. Work will begin about September 1, 1916, and continue for about eight months, if the river stages will permit. This work and the care and repair of plant after operations are suspended will exhaust the balance by June 30, 1917.

The balance of \$71,597.39 available during the fiscal year 1917 for the lock-and-dam and open-channel work will be applied to comple-

tion of this project. Of this amount \$21,597.39 will be used to complete the lock and dam, as shown in the following table:

Decking cribs-----	\$600. 00
Completion of riprap paving-----	600. 00
Constructing 4 miles of telephone line-----	800. 00
Constructing and equipping maneuvering boat-----	7, 000. 00
Care of plant-----	500. 00
Testing dam and contingencies-----	12, 097. 39
Total-----	21, 597. 39

This work will be done as soon as the river reaches a favorable stage, and the funds will probably be exhausted before October 31, 1916. The \$50,000 remaining will be expended in open-channel and contraction work required by the project between Jones Bayou and the mouth of the Hushpuckena River. This will be done by dredging the channel with the U. S. dredge *Waterway*, and depositing the spoil along the sides to reduce the width of the river, at a cost of about \$4,000 per month. Work will probably begin November 1, 1916, and the balance will be exhausted in about one year thereafter.

The sum for which estimate is submitted for maintenance of the improvement during the fiscal year ending June 30, 1918, should be applied to removing snags and other obstructions from the river between its mouth and the mouth of the Hushpuckena River, and to necessary dredging of shoals below the lock and dam. The work should be done at low water by U. S. derrick boat *No. 1*. New obstructions are forming continually, which should be removed if navigation is to be maintained.

Commercial statistics.—All commerce on this stream has been directly benefited by its improvement. Boats usually draw about 3 feet, loaded. Statistics have been compiled for the fiscal instead of the calendar year because the former more nearly coincides with the commercial year.

Comparative statement.

Fiscal year ending June 30—	Short tons.	Value.
1914.....	92,024	\$1,705,554
1915.....	98,141	1,817,083
1916.....	57,410	1,694,683

The freight carried during the current fiscal year consisted of lumber and logs, farm products, and general merchandise.

Balance available for fiscal year ending June 30, 1917-----	\$71, 597. 39
Amount expended on all projects March 3, 1879, to June 30, 1916:	
New work-----	360, 601. 22
Maintenance and new work (inseparable)-----	256, 992. 88
Total-----	617, 594. 10
Balance available for fiscal year ending June 30, 1917-----	87, 520. 15
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	(¹)

¹ See consolidated "Financial summary" on page following report on Big Sunflower River.

CONSOLIDATED.

Amount expended on all projects from March 3, 1873, to June 30, 1916:

New work (estimated)-----	\$395, 832. 73
Maintenance and new work (inseparable, estimated)-----	909, 123. 94
Total-----	1, 304, 956. 67
Balance available for fiscal year ending June 30, 1917-----	124, 029. 64
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	20, 000. 00

SOUTHWEST PASS, MISSISSIPPI RIVER, LA.

Location and description.—Southwest Pass is the westernmost of the mouths of the Mississippi River. Its length from Head of Passes to the Gulf of Mexico is $19\frac{1}{2}$ miles. It flows in a generally southwest direction. Distance of outer end of Pass from New Orleans, La., is 119 statute miles; from Mobile, Ala., 160 statute miles; from Galveston, Tex., 330 statute miles. Average width is 2,000 feet; the narrowest section is 1,190 feet, widest section 4,950 feet. It is a tidal stream, but about eight months of the year is influenced by river floods. During floods the fall is about 5 feet between head and gulf.

Existing project.—The existing project, adopted by the river and harbor act approved June 13, 1902, provides for securing by dredging a channel throughout Southwest Pass 1,000 feet wide and 35 feet deep at mean low water, at an estimated cost of \$6,000,000, and \$150,000 per annum for maintenance. The plan of improvement includes the construction of jetties to protect the dredged channel at the mouth of the Pass, the closure of minor outlets to the Pass itself, and the construction of sills to prevent the enlargement of the outlets to the river above the Pass; but the act of 1902 provides that the details of the work may be modified at the discretion of the Secretary of War. (See H. Doc. No. 329, 56th Cong., 1st sess.) By the act of May 28, 1908, dredging in the river at the Head of Passes and as far up as Cubits Gap, a distance of $3\frac{1}{2}$ miles, was authorized whenever necessary to secure a depth of 35 feet, with a practicable width; and by the river and harbor act approved March 3, 1909, provision was made for increasing the plant by the addition of a larger dredge. These additions to the work were made without prior increase of the estimate of cost. The contraction works hitherto constructed having failed to secure the full effect for which they were designed, additional works at an estimated cost of \$4,600,000 have been planned by a board of engineer officers, convened for this purpose, whose report is found at page 2420 of the Annual Report of the Chief of Engineers for 1916. Including expenditures already made for original work, the revised estimate of cost becomes about \$12,400,000. The estimate for annual cost of maintenance has been increased to \$300,000. The average variation, due to tides, is 16 inches.

Condition at the end of fiscal year.—The foundation of east jetty is 24,600 feet long and the length above high water is 23,900 feet. West jetty foundation is 18,830 feet and length above high water is 18,400 feet. This work was done in 1904 to 1913. Jetty

superstructure was repaired during 1915 and 1916. During 1908 to 1913 mattresses were added to the sill at head of Pass a Loutre; mattress sills placed across Cubits Gap and The Jump; 11 outlet bayous in the pass were closed; old mattress sill across head of pass removed; and 14 spur dikes constructed in the lower 7 miles of pass. There has been removed prior to July 1, 1915, from the lower 7 miles of channel by dredging 32,445,667 cubic yards of sand and mud. The yardage to be removed to secure a 35-foot channel 1,000 feet wide at the end of the year was 5,140,870 cubic yards; on this basis the project is considered 72 per cent completed. Controlling depths during year varied from 21 to 28 feet, and on June 30 was 26 feet. To June 30, 1916, the amount expended under the existing project was \$7,080,205.20 for improvement, \$23,833.27 for surveys and examinations, and \$1,834,964.84 for maintenance, a total of \$8,939,003.31.

Local cooperation.—There has been no local cooperation imposed by law. There is a system of public docks at New Orleans, La., operated by the State board of commissioners for the port of New Orleans, La., involving 27,000 linear feet of wharf, 3,777,166 square feet of wharf area, and 2,558,906 square feet of roof area; total cost, approximately \$4,000,000. The State board of commissioners are also building 6 State warehouses, 2 sheds, and 4 wharf sheds for cotton, with terminal trackage to the capacity of 2,500 cars, or sufficient to handle a daily movement of 1,000 loaded cars, the above buildings and terminals being built on the east bank of the Mississippi River, in New Orleans, La., beginning near Napoleon Avenue and extending upstream about 2,000 feet. The warehouses and sheds have a storage capacity of from 450,000 to 600,000 bales of cotton, which is equivalent to an annual handling capacity of 2,000,000 bales. Cost of above, approximately \$3,500,000; total area covered, approximately 100 acres. General design of warehouses, sheds, and terminals embodies the latest improvements and developments that have been proven successful in other large ports, one feature of which being the direct loading and unloading from cars to ship's tackle by means of depressed railroad tracks and also tracks on apron of wharf, which allow loading and unloading directly into ships and vice versa.

Effect of improvement.—Channel has been increased in depth from 9 to 24 feet over bars at entrance and at head of pass, respectively, to 24-foot depth, and 31 feet throughout the pass, at end of the fiscal year. Freight rates have been reduced and greater cargoes carried, both for domestic and foreign commerce.

Proposed operations.—It is proposed to expend the funds available for fiscal year ending June 30, 1917, as follows:

Operation and repairs to dredges <i>Benyuard</i> and <i>New Orleans</i> -----	\$200, 000. 00
Operation of tug, survey boat, and other floating plant-----	30, 000. 00
Upkeep of shore plant, machine shop, refrigerating plant, etc-----	30, 000. 00
Maintenance and repair of existing spur dikes and dams across outlet bayous, Southwest Pass-----	40, 000. 00
Proposed work to be done as may be recommended by board of officers appointed for this improvement, as may be approved-----	550, 000. 00
Contingencies -----	27, 448. 41
Total -----	877, 448. 41

The estimate of funds for fiscal year 1918 is submitted in detail, as follows:

Operating and repairs, dredges <i>Benyuard</i> and <i>New Orleans</i> , and accessories at \$100,000 per annum each-----	\$200, 000
Operating of tug <i>C. Donovan</i> , survey boat <i>Picket</i> , and other floating plant, consisting of barges, derrick, and pile driver-----	25, 000
Upkeep of shore plant, machine shop, refrigerating plant, etc-----	25, 000
Maintenance and repair of existing spur dikes and dams across outlet bayous-----	25, 000
Proposed work to be done as recommended by board of officers appointed for this improvement, and as may be approved-----	1, 600, 000
Superintendence and contingencies-----	125, 000
Total -----	2, 000, 000

During this period it is expected to continue the work of maintaining the jetties, the channel, and make considerable progress toward securing a complete 35-foot channel, 1,000 feet wide, in accordance with the project.

Commercial statistics.—A comparative statement of foreign and domestic receipts and shipments for the past three years for the port of New Orleans, La., is as follows:

Calendar year.	Foreign.		Domestic.		Total.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1913.....	5,370,491	\$261,176,635	1,072,441	\$53,905,897	6,442,932	\$315,082,532
1914.....	5,053,060	260,708,811	1,219,952	50,849,050	6,273,012	311,557,861
1915.....	5,252,475	300,832,524	1,283,657	67,689,761	6,536,132	368,522,285

The commercial statistics are those for the port of New Orleans, La., and are the same for both South and Southwest Pass improvements, there being no certain method of ascertaining the commerce for each Pass separately. Based on vessels drawing 25 feet or more, about 9 per cent went through Southwest Pass and 91 per cent through South Pass.

Amount expended on all projects from July 4, 1836, to June 30, 1916:

New work-----	\$8, 025, 881. 48
Maintenance -----	1, 834, 964. 84
Total -----	9, 860, 046. 32
Balance available for fiscal year ending June 30, 1917-----	877, 448. 41
Amount (estimated) required to be appropriated for completion of existing project-----	3, 820, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement and for maintenance--	2, 000, 000. 00

SOUTH PASS CHANNEL, MISSISSIPPI RIVER, LA.

Location and description.—South Pass, flowing south 32° east, is the smallest of the three main outlets of the Mississippi River. Its length from Head of Passes to the Gulf of Mexico is about 14 miles, and its average width is 700 feet. It is a tidal stream, but during about eight months each year the flow is chiefly influenced by river

floods. With the crests of the floods the fall is about 5 feet between river and Gulf, and South Pass discharges 125,000 cubic feet per second. The entrance is 107 miles from New Orleans, La.; 141 miles from Mobile, Ala.; and 349 miles from Galveston, Tex.

Existing project.—The present project was adopted in accordance with river and harbor act of March 3, 1875, amended by acts of June 19, 1878, and March 3, 1879, authorizing James B. Eads and associates to “construct such permanent and sufficient jetties and such auxiliary works as are necessary to create and permanently maintain a wide and deep channel between the South Pass of the Mississippi River and the Gulf of Mexico.” This included securing and maintaining through the Pass and through the jetties at the mouth of the Pass a channel 26 feet in depth and not less than 200 feet in width at the bottom, and having through it a central depth of 30 feet without regard to width. The channel was secured July 8, 1879, and on that day began the period of 20 years’ maintenance. This period ended January 28, 1901. The emergency act of June 6, 1900, provided for maintaining by the United States, after termination of contract with Mr. Eads, the channel secured, and appropriated a sum not exceeding \$100,000 annually for this work. The river and harbor act of May 28, 1908, authorized the use of funds for this improvement to dredge a channel 35 feet deep—no width specified—through shoals in the river between Cubits Gap and Head of Passes. Variation of water surface is from zero at the mouth to 2 feet at the head of the Pass, due to the stage of the river, and from 1.3 feet at the mouth to 0.9 foot at the head, due to tide. For latest charts of South Pass and Head of Passes, see Annual Report for 1915, page 2580.

Condition at the end of fiscal year.—East jetty foundation is 12,070 feet, and above high water jetty has a length of 11,720 feet. Inner east jetty is 11,170 feet long. The west jetty is 7,820 feet long, and above high water jetty is 7,520. Inner west jetty is 4,710 feet long. The main jetties were completed in 1879 and the inner jetties in 1886. The upper dam, cut-off dike, west dike, 8 wing dams in Grand Bayou, and 36 wing dams in jetty channel were completed in 1880. The channel was dredged on about 1,230 days during the 20-year maintenance. The navigable depth was increased from 9 to 26 feet at the mouth and from 13 to — feet at the head of the Pass. The amounts paid to James P. Eads and associates under the contract, and maintenance, were \$8,000,000. Under maintenance by the United States the inner east jetty was extended 797 feet shoreward, and 46,950 square yards of mattress have been placed for bank revetment. Nearly 7,000,000 cubic yards of material has been dredged from the channel. The discharge has increased 62 per cent, causing serious bank caves and undermining of the works. The bar has advanced, making the maintenance more difficult. Work to prevent further enlargement of the Pass is under way. Under the existing project there has been expended to June 30, 1916, \$8,000,000 for improvement and \$1,879,080.55¹ for maintenance, a combined total of \$9,879,080.55.

Local cooperation.—There is no local cooperation imposed by law. For description of the public docks, warehouses, and wharf sheds at New Orleans, La., see report for Southwest Pass, Mississippi River.

¹ To June 30, 1915, \$1,738,422 was expended in lieu of \$1,739,341.38, as stated in report for 1915, p. 803, the former found to be correct after rechecking.

Effect of improvement.—The navigable depth of the channel has increased from 9 to 31½ feet at the mouth, and from 13 to 31½ feet at the head of the Pass. Larger and deeper draft vessels are permitted to enter the harbor at New Orleans, La., giving that city high rank as a seaport. Larger cargoes are carried for coastwise and foreign commerce. The water rates to New York are 40 per cent less than the rail rates.

Proposed operations.—It is proposed to extend the funds available for the fiscal year ending June 30, 1917, as follows:

Repairs to work near mouth of the Pass	\$35, 000
Repairs to dikes along the Pass and at the head of Pass	12, 000
Upkeep and maintenance of tugs, barges, pile driver and derrick, houses, shore plant, including coaling plant	38, 000
Dredging and repairs to dredges	65, 000
Revetment work and removal of west dike at head of Pass (part)	10, 000
Bank protection and sill across the head of South Pass (part)	80, 000
Contingencies	10, 000
Total	250, 000

There should be provided for the fiscal year 1918 \$150,000, in addition to the \$100,000 which becomes available for fiscal year 1918. The increase in the estimate is due to the enlarging of South Pass and the consequent caving of banks and shoaling in the seaward approach, which requires practically continuous dredging. The estimate for the \$150,000 additional required, in detail, is as follows:

Repairs to existing jetties and spur dikes	\$25, 000
Dredging and repairs to dredges	75, 000
Caving banks, mattresses, etc	35, 000
Contingencies	15, 000
Total	150, 000

Commercial statistics.—The commercial statistics are those for the port of New Orleans, La., and are the same for both South and Southwest Pass improvements, there being no certain method of ascertaining the commerce for each pass separately. (See report on Southwest Pass improvement, p. 853.) Based on vessels drawing 25 feet or more, about 9 per cent went through Southwest Pass and 91 per cent through South Pass. However, it is not to be inferred from this statement that many of the vessels which were taken through South Pass could not have been taken through Southwest Pass as well.

Amount expended on all projects from Mar. 3, 1875, to June 30, 1916:

New work	\$8, 000, 000. 00
Maintenance	1, 879, 080. 55
Total	9, 879, 080. 55

Balance available for fiscal year ending June 30, 1917	250, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	¹ 150, 000. 00

BAYOU PLAQUEMINE, GRAND RIVER, AND PIGEON BAYOUS, LA.

Location and description.—Bayou Plaquemine lies in the south-central part of Louisiana, and connects with the Mississippi River by

¹In addition to the permanent annual appropriation of \$100,000 provided by the river and harbor act of June 6, 1900.

Plaquemine Lock, 112 miles above New Orleans, La. The waterway from Plaquemine to Morgan City, La., consists of Bayou Plaquemine, 10.6 miles; Grand River (one of the channels of the Atchafalaya River), 19.4 miles; Bay Natchez, 6 miles; Little Goddel and Big Goddel, 6 miles; Belle River, 9 miles; Bayou Long, 7.3 miles; Flat Lake and Drews Pass to Berwick Bay, 3.2 miles; and thence by the Atchafalaya River to Morgan City, 2.5 miles. Pigeon Bayous consist of Pigeon Bayou and its outlet tributary Little Pigeon Bayou, and connects Grand River with Grand Lake, flowing from the former stream 14 miles below the mouth of Bayou Plaquemine. The entire waterway from Plaquemine to Morgan City, about 64 miles in length, is included in the project. Pigeon Bayous, with an aggregate length of about 26 miles, are also included.

Existing project.—The existing project, adopted by the river and harbor act of August 11, 1888, provides for a water route from the lower Atchafalaya River to the Mississippi River at Plaquemine, by means of a lock and by dredging and removing obstructions in the waterway of the route; also for securing the mouth of the bayou from caving of its banks; all at an estimated cost of \$1,708,250. (See S. Ex. Doc. No. 121, 49th Cong., 2d sess., and Annual Report for 1887, p. 1405; no maps.) The lock has solid concrete walls and floor resting upon pile foundation. It has also four sets of steel operating gates and one set of steel guard gates. The length between miter sills is 298 feet 7 inches; clear width, 55 feet; depth over sills at low water, 10 feet. The lift depends upon stage of river, varying from 0 to 28 feet. The river and harbor act of July 13, 1892, and subsequent acts authorized the use of funds appropriated for this work in the improvement of Pigeon Bayous. The river and harbor act of March 3, 1905, authorized entering into contract revising cost to \$1,740,000, and the river and harbor act of March 2, 1907, appropriated \$100,000 for construction of a dredge and for maintenance. In 1899 the rectifying of Bayou Plaquemine and making a channel from Plaquemine to Morgan City 125 feet wide at surface, 95 feet wide at bottom, and 10 feet deep, by dredging and removing snags and other obstructions, was authorized. Mean low water in Bayou Plaquemine is 1.24 feet above mean low Gulf. The mean tidal variation at Morgan City is 10 inches; at Plaquemine, about 2 to 3 inches.

Condition at the end of fiscal year.—The work of securing the mouth of Bayou Plaquemine against caving was completed in 1894. Work consisted of five submerged spur dikes placed at intervals of 900 feet, with intervals protected by revetment. The lock was completed at a cost of \$1,302,006.38, and placed in operation July 1, 1909; approaches and fill were completed in 1911. Bayou Plaquemine, the Grand River system, and the Pigeon Bayous have been dredged and snagged. The improvement is considered completed. There is now a through water route from the Mississippi River at Plaquemine to Morgan City, available throughout the year, with a depth of 9 feet or more at mean low water, except where shoaling has occurred in Bay Natchez, mile 30 to mile 36, 8 feet; Flat Lake, mile 58.3 to mile 61.3, 6 feet; and Pigeon Bayous, 7 feet, miles being reckoned from Plaquemine Lock downstream. To June 30, 1916, there was expended \$1,844,035.64 for improvement, \$120,441.65 for maintenance, a combined total of \$1,964,477.29.

Effect of improvement.—The channel has been deepened from 4 to 6 feet in Flat Lake and from 4 to 9 feet in other portions of the waterway. Effect on freight rates has been marked. The rates from New Orleans to Morgan City and other points along Bayou Teche, where the railroad touches, are much less than they were previous to the improvement.

Proposed operations.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Dredging in Flat Lake, Bay Natchez, and Bayou Plaquemine-----	\$26, 747. 66
Placing channel markers in Plaquemine to Morgan City Waterway--	7, 000. 00
Removing obstructions-----	3, 000. 00
Supervision and office expenses-----	8, 000. 00
Total-----	44, 747. 66

Operations will be begun in August, 1916, and prosecuted continuously until December, 1916, and thereafter work will be dependent upon the availability of plant.

Funds for fiscal year 1918 are requested for maintenance, as follows:

Dredging 90,000 cubic yards of material in Plaquemine-to-Morgan City Waterway, at 20 cents-----	\$18, 000
Superintendence, inspection, and contingencies-----	2, 000
Total-----	20, 000

Commercial statistics.—A comparative statement of shipments and receipts for the past three years is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	976, 701	\$7, 576, 795
1914.....	876, 667	21, 593, 942
1915.....	888, 142	17, 435, 899

The tonnage for the calendar year 1915 consisted principally of lumber, logs, gravel, fuel oil, sugar cane, corn, and miscellaneous merchandise. The draft of vessels operating on the stream varies from 3 feet 6 inches to 7 feet. Lumber, logs, sugar cane, fuel oil, and miscellaneous merchandise, which comprise over 99 per cent of the total tonnage, require boats of 4 to 7 foot draft.

Amount expended on all projects from Aug. 11, 1888, to June 30, 1916:

New work-----	\$1, 844, 035. 64
Maintenance-----	120, 441. 65
Total-----	1, 964, 477. 29
Balance available for fiscal year ending June 30, 1917-----	44, 747. 66
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance and improvement-----	20, 000. 00

BAYOU TECHE, LA.

Location and description.—Bayou Teche has its source in Bayou Courtableau in St. Landry Parish and flows in a southeasterly direction a distance of 125 miles to where it joins the lower Atchafalaya

River, about 10 miles above Morgan City, La. Portion under improvement is from its mouth to Arnaudville, La., a distance of 107 miles. Bayou Teche is tidal to Keystone Lock, and above that lock varies as the pool level.

Existing project.—The existing project is based on river and harbor act of September 19, 1890, limiting the expenditure of funds to the improvement of the stream from the mouth to St. Martinville by removing snags and other obstructions and dredging, at an estimated first cost of \$7,500 and \$1,000 annually for maintenance. (See Annual Report for 1889, p. 1532.) The river and harbor act of March 2, 1907, modified and extended the improvement, in accordance with report published in House Document No. 527, Fifty-ninth Congress, first session, and provided for a channel 50 feet width and 6 feet depth to Arnaudville, La., by dredging, removal of snags and overhanging trees, and by construction of a lock at Keystone Plantation and other regulating works. Estimated cost, \$111,000, subsequently increased to \$275,000. The lock has a length between miter sills of 183 feet 10 $\frac{3}{4}$ inches, a clear width of 36 feet, a depth over sill at mean low Gulf of 8 feet, and a lift of 8 feet. The dam is 175 feet long with crest 8 feet above mean low Gulf. The plane of reference is mean low Gulf. The mean tidal variation at mouth is 10 inches, at lock 4 inches, and above Keystone Lock nothing. The latest published map is in House Document No. 1329, Sixty-second Congress, third session.

Condition at the end of fiscal year.—The project is completed. The Keystone Lock and Dam was completed June 30, 1913, at a cost of \$257,720.48. Controlling gates have been placed in the canal feeder from Spanish Lake, and a small dam has been constructed across Bayou Vermilion at its junction with Bayou Fusilier. Under various appropriations since 1871 the stream has been snagged and dredged from mouth to head. Redredging will be needed for 8.5 miles below Arnaudville, and from mile 10.04 below Keystone Lock to Jeanerette, La. The dredging does not afford a permanent channel, and annual maintenance will be needed. The present available depths are: From mouth to Franklin, 8 feet mean low Gulf; to New Iberia, 5 feet; from New Iberia to mile 10.04 below Keystone Lock, 4 feet; from mile 10.04 below lock to mile 26 above lock, 6 feet; and from mile 26 above lock to Arnaudville, 4 feet. There was expended to June 30, 1916, \$372,804.93 for improvement and \$37,835.97 for maintenance, a combined total of \$410,640.90.

Local cooperation.—Expenditure for 6-foot navigation to Arnaudville, La., was contingent upon all lands necessary for lock and dam purposes (and canal feeders) being deeded to the United States free of cost and upon the United States being secured against all possible claims for loss or damage resulting from the overflow of lands by reason of the lock and dam improvement or from the draining of Spanish Lake. The land for lock and dam site was deeded to the United States in 1909. As to securing the United States from claims for loss or damage from overflow of land, it was impossible to secure bonds in perpetuity, and this requirement, therefore, was effected by the submission of personal bonds amounting to \$10,000, covering a period of 10 years, which was approved by the department September 10, 1909.

Effect of improvement.—Effect on freight rates was very marked. Rates from New Orleans, La., to point where railroad touches the bayou are considerably less than the nearer points on the same line not on the banks of the stream. This improvement, connecting the Plaquemine waterway and the Mississippi River, gives a through waterway to New Orleans, La.

Proposed operations.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Proposed increase in present contract for dredging.....	\$6, 250. 00
Dredging and removing obstructions.....	5, 777. 77
Supervision and office expenses.....	5, 000. 00
Total.....	17, 027. 77

Operations under contract will be continued until completion, and other operations will probably be begun in November, 1916, and prosecuted continuously until completion.

The funds requested for fiscal year 1918 will be expended as follows:

Dredging shoals, 90,000 cubic yards, at 10 cents.....	\$9,000
Inspection, superintendence, and contingencies.....	1, 000
Total.....	10, 000

While the estimate is larger than the average expenditure for maintenance during the past three years, the improvement has only recently been completed; the former maintenance was only for a portion of the improvement. The greater part of the improved channel has deteriorated, and with the entire improvement under maintenance the annual cost will be greater. The banks are soft and caving and considerable dredging will be required.

Commercial statistics.—A comparative statement of shipments and receipts for the past three years is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	615, 106	\$6, 334, 699
1914.....	539, 150	12, 927, 208
1915.....	597, 741	11, 525, 718

The tonnage for the calendar year 1915 consisted principally of logs, lumber, gravel, sugar cane, fuel oil, and miscellaneous merchandise. The draft of vessels necessary to carry the commerce varied from 3 feet 6 inches to 7 feet. Logs, which comprise 73 per cent; cane, 6 per cent; and miscellaneous merchandise, 9 per cent of the total tonnage, were carried in vessels of a draft of 4 to 7 feet. Fuel oil, which comprises approximately 5 per cent of the total tonnage, required vessels drawing 7 feet of water.

Amount expended on all projects from July 11, 1870, to June 30, 1916:

New work.....	\$418, 509. 36
Maintenance.....	37, 835. 97
Total.....	456, 345. 33

Balance available for fiscal year ending June 30, 1917.....	17, 027. 77
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	10, 000. 00

INTRACOASTAL WATERWAY, FRANKLIN TO MERMENTAU, LA.

Location and description.—This waterway extends from Bayou Teche to Mermentau River, La., and is a continuation of the waterway from Sabine River to Mermentau River.

Teche-Vermilion section: This section begins on west bank of Bayou Teche just below Franklin, La., and extends through what is known as the Hanson Canal for 4.2 miles; thence through Bayous Portage and Bartholomew to Little Bay (the Jaws) 5.5 miles; thence through west Cote Blanche and Vermilion Bays 38.3 miles; making a total distance of 48 miles.

Vermilion-Mermentau section: This section extends through Schooner Bayou and Schooner Bayou Canal for 12 miles; thence across White Lake 13.5 miles; thence through dredged canals, connecting Turtle, Alligator, and Collicon Lakes, to Grand Lake 6.5 miles; and thence across Grand Lake 12 miles to Mermentau River; making a total distance of 45 miles.

The total length of the combined sections is 93 miles.

Existing project.—The existing project was adopted by act of March 2, 1907, and provides for a waterway from Bayou Teche, at or near Franklin, La., to Mermentau River, having a depth of 5 feet at low water (mean low Gulf) and bottom width of 40 feet, with appropriate side slopes, at an estimated cost of \$289,292 and annual cost for maintenance of \$20,000. (See H. Doc. No. 640, 59th Cong., 2d sess., with map.) To prevent salt water entering White Lake, a lock was constructed, of tidal type, with two wooden gates turning on horizontal hinges at bottom. The dimensions are 300 feet by 36 feet, by 8 feet over sill at mean low Gulf. To allow sufficient drainage around the old bend of Schooner Bayou, opposite the lock, a spillway dam, of platform type, resting on piles, was constructed in 1915. The flow of water is controlled by five wooden gates, 12 feet 8 inches wide and 9 feet 11 inches high, hinged at top to top of framework of dam. The elevation of the sill is 6 feet below mean low Gulf.

The acts of March 3, 1909, and of February 27, 1911, authorized the Secretary of War to make such changes in location of the channel as might be desirable. River and harbor act of July 25, 1912, authorized the Secretary of War to purchase, as part of this waterway, the so-called Hanson Canal, between Bayou Teche and Cote Blanche Bay, at a cost not to exceed \$65,000, to be paid from funds already appropriated. The mean tidal variation is 10 inches. The latest published map accompanies House Document No. 610, Sixty-third Congress, second session.

Condition at the end of fiscal year.—Teche-Vermilion section: Papers for the transfer of the Hanson Canal to the United States have been prepared, but have not yet been approved by the Department of Justice. No work outside of surveys has been done in this section. Vermilion-Mermentau section: A channel 5 feet deep at mean low Gulf and 40 feet wide on bottom has been dredged from the 5-foot contour in Vermilion Bay, via Schooner Bayou, White Lake, Turtle Lake, Alligator Lake, and Collicon Lake, the several lakes being connected by making cuts through the marsh. This channel was completed in fiscal year 1912. A tide lock, at a cost of \$40,018.10 (completed in fiscal year 1913), and timber spillway dam, at a cost of \$8,500 (completed in 1915), were constructed in Schooner

Bayou. This section has been completed to project dimensions, and a 5-foot depth at mean low Gulf was available throughout the year.

The entire project from Franklin to Mermentau is considered 60 per cent completed on present approved route. To June 30, 1917, there were expended \$168,727.58 for improvement and \$5,208.90 for maintenance, or a combined total of \$173,936.48.

Local cooperation.—The project provides that rights of way for the canal be furnished to the United States free of cost, with the exception of the Hanson Canal. Strips of land 300 feet wide were deeded to the United States for the canal, from Vermilion Bay to Grand Lake, and accepted by the department March 13, 1909.

Effect of improvement.—A safe route, without exposure to dangers of Gulf navigation, has been provided for vessels operating the Vermilion-Mermentau section. The through waterway not being completed, it is not known what effect it will have on freight rates, but the completed portion serves a section heretofore without any means of access to railroads.

Proposed operations.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Purchase of the Hanson Canal-----	\$65,000.00
Construction of one railroad bridge-----	60,000.00
Construction of one highway bridge-----	2,000.00
Construction of lock-master's house-----	3,500.00
Dredging Vermilion-Mermentau section-----	6,000.00
Supervision and office expenses-----	5,273.05
Total -----	141,773.05

Operations on first three items are dependent upon the perfection of papers for the purchase of Hanson Canal; the funds should be expended in 1917. Construction of lock-master's house will be begun in October, 1916, and work will be prosecuted continuously until completion. Dredging will probably be begun in the fall of 1916 and prosecuted as the availability of plant will permit.

For the fiscal year 1918, \$8,000, in addition to the above amount, will be needed for maintenance (80,000 cubic yards of dredging at 10 cents, \$8,000).

Commercial statistics.—A comparative statement of shipments and receipts for the past three years is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	5,912	\$106,456
1914.....	3,477	188,428
1915.....	4,485	274,594

The Vermilion-Mermentau section of this waterway is completed, and the estimate is for maintenance of the completed portion through the lakes and bays, which is subject to constant shoaling. Shoaling has now reached such a condition that more extensive dredging will be required in the future.

The tonnage for the calendar year consisted principally of coal, farm and dairy products, rice, and miscellaneous merchandise. The draft of vessels varied from 4 to 5 feet. Coal, which comprises 45

per cent of the total tonnage, required vessels of 4-foot draft, and miscellaneous merchandise, which comprises approximately 50 per cent of the total tonnage, required vessels of 5-foot draft.

Amount expended on all projects from Mar. 2, 1907, to June 30, 1916:

New work -----	\$168, 727. 58
Maintenance -----	5, 208. 90
Total -----	<u>173, 936. 48</u>
Balance available for fiscal year ending June 30, 1917 -----	141, 773. 05
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement -----	8, 000. 00

INTRACOASTAL WATERWAY, MERMENTAU RIVER TO SABINE RIVER, LA. AND TEX.

Location and description.—This waterway extends from Mermentau River, La., to Sabine River, La. and Tex., and is a continuation of the waterway from Franklin to Mermentau, La.

Mermentau-Calcasieu section: The inland waterway from Mermentau River to Calcasieu River begins at the west bank of the Mermentau River about 1 mile above its entrance into Grand Lake. The accepted route then runs in a west-southwesterly direction to the east end of the Lake Misere Canal, passing north of Lake and Bayou Misere. Then Lake Misere Canal is used to about 1 mile from Sweet Lake. It then passes south of Sweet Lake, following edge of lake to Sweet Lake Canal, from which it extends in a northwesterly direction to Calcasieu River. The total distance is 37.5 miles. From the mouth of Black Bayou to the entrance in Calcasieu River of the Calcasieu to Sabine section is about 2 miles.

Calcasieu-Sabine section: The waterway begins at a point on west bank of Calcasieu River about 20 miles below Lake Charles, La. It then runs a little south of west for 1.41 miles; then about southwest for 0.69 mile; then due west for 20.4 miles to entrance into Sabine River; total length being 22.5 miles. The Sabine entrance is 3 miles below Orange, Tex. The total distance from Mermentau to Sabine is 62 miles.

Existing project.—The existing project provides for a waterway from Mermentau River, La., to Sabine River, La. and Tex., with a depth of 5 feet at mean low Gulf and a width of 40 feet at bottom, with proper side slopes, at an estimated cost of \$390,000 and \$20,000 annually for maintenance. The project was adopted by the river and harbor act of June 25, 1910, and is based on report of the Board of Engineers for Rivers and Harbors, printed in River and Harbor Committee Document No. 3, Sixty-first Congress, second session. This act and subsequent appropriation acts provide that the money may be applied to any modified plan for this section of the waterway that may be recommended by the Chief of Engineers United States Army, and approved by the Secretary of War. The latest published map accompanies House Document No. 610, Sixty-third Congress, second session. The mean tidal variation is 10 inches.

Condition at the end of fiscal year.—Mermentau-Calcasieu section: Activities on this section have been limited to surveying and

securing deeds and abstracts for rights of way. The deeds for right of way were secured in the fiscal year 1916, and abstracts are under way.

Calcasieu-Sabine section: The canal over this section was completed during the fiscal year 1915, and a depth of 5 feet at mean low Gulf was available throughout the year.

The project is about 42 per cent completed. The remaining work consists of dredging a canal from Mermentau River to Calcasieu River. To June 30, 1916, \$125,284.22, and \$13,266.97 from contributed funds, were expended for improvement, a combined total of \$138,551.19.

Local cooperation.—The report on which the adopted project is based provides that the rights of way shall be furnished free of cost to the United States. A right of way 300 feet wide, from Calcasieu River to Sabine River, has been deeded to the United States and accepted by the department January 15, 1913. The deeds for section from Mermentau River to Calcasieu River have all been secured; abstracts are now being prepared and should be ready for forwarding to the Department of Justice by August 1, 1916. Local interests desired that the location of canal from Calcasieu River to Sabine River be changed from that of the adopted route, in order to secure a shorter and straighter route, and consented to bear the difference in cost. The canal was dredged accordingly. Local interests contributed \$27,450, of which only \$13,266.97 was used, the remainder reverting to the contributors.

Effect of improvement.—Although the canal from Calcasieu River to Sabine River has been opened for only a year, considerable commerce has developed. A safe inland route is now provided for small craft and the improvement has had a tendency to reduce freight rates. Greater benefits will be felt when the entire canal is completed.

Proposed operations.—It is proposed to expend the funds available for the fiscal year ending June 30, 1916, as follows:

Completing Mermentau-Calcasieu section.....	\$260, 000. 00
Dredging Calcasieu-Sabine section.....	8, 000. 00
Supervision and office expenses.....	11, 502. 03
Total	279, 502. 03

Operations will be begun under item 1 as soon as rights of way are approved and prosecuted continuously until completed. The dredging will probably be begun some time in 1917, when plant is available.

Funds for fiscal year 1918 are requested for maintenance, as follows:

Dredging shoals	\$1, 800
Supervision and office expenses.....	200
Total	2, 000

The Calcasieu-Sabine section of this waterway was completed in 1915, and no maintenance work has been done as yet, but will be required during this year. The isolated locality makes the transfer of plant expensive, and the amount requested is considered necessary.

Commercial statistics.—A comparative statement of shipments and receipts for the past year over the completed portions of the Calcasieu-Sabine section then under construction is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1914.....	712	\$25, 387
1915.....	14, 308	597, 682

The commerce is for the completed portion of the waterway from Calcasieu River to Sabine River, La. and Tex. The tonnage for the calendar year 1915 consisted principally of live stock, shells, lumber, and miscellaneous merchandise. The usual limits of draft for loaded boats were from 3 to 5 feet. Live stock, lumber, and miscellaneous merchandise, which comprise about 64 per cent of the total tonnage, required vessels of 5-foot draft, while shells, which comprise about 29 per cent of the total tonnage, required vessels of a draft of 3 feet 6 inches.

Amount expended on all projects from June 25, 1910, to June 30, 1916, new work.....	\$138, 551. 19
Balance available for fiscal year ending June 30, 1917.....	279, 502. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	2, 000. 00

INTRACOASTAL WATERWAY FROM MISSISSIPPI RIVER TO BAYOU TECHE, LA.—NEW PROJECT.

Reports of the Board of Engineers and Chief of Engineers printed in House Document 610, Sixty-third Congress, second session:

REPORT OF THE BOARD OF ENGINEERS.

There are a number of possible routes over this section of the waterway. A number of lakes and bayous exist, and there are two privately owned canals covering a part of this reach. Estimates have been submitted in considerable detail for several of the most feasible routes, some of which involve the acquisition of the private canals. In the latter cases the estimate for the entire reach can be only approximately determined in view of the fact that no definite proposition for the sale of either of the private canals has been obtained, it being stated by the owners of these canals that if their purchase was desired they could be bought at their actual cost, the exact figure not being given. The estimates are summarized as follows:

Route.	7 feet deep, 75 feet bottom width.	5 feet deep, 40 feet bottom width.
1a. New route, through Lake Salvador.....	\$1, 655, 500	\$826, 000
1b. Harvey Canal route, through Lake Salvador.....	¹ 1, 102, 205	¹ 364, 634
1c. Company Canal route, through Lake Salvador.....	² 1, 173, 751	² 254, 834
2a. New route, skirting Lake Salvador.....	2, 062, 900	986, 500
2b. Harvey Canal route, skirting Lake Salvador.....	¹ 1, 151, 837	¹ 732, 734
2c. Company Canal route, skirting Lake Salvador.....	² 1, 447, 940	² 378, 041

¹ Exclusive of cost of Harvey Canal property. ² Exclusive of cost of Company Canal property.

The special board recommends the construction of an inland waterway over this reach 7 feet deep and 75 feet bottom width, the route to follow either the

Harvey or Company Canal if either of these properties or portions of them can be acquired at such price as would make the total cost less than that for new work, and in case this can not be done that a new route be selected as indicated. In view of the less cost it is recommended that the route through Lake Salvador be selected, and thence as described.

As stated within, a free waterway of adequate dimensions would be of great value to this section of country, where, owing to its low-lying lands and the great number of natural waterways, railroad construction would be very difficult, while water routes may be constructed at moderate cost. The practicability of this work has been shown through the construction of a number of private canals in this vicinity which are extensively used for general transportation purposes. In view of the fact that Congress has already adopted a depth of 5 feet for certain inland waterways through Louisiana and Texas, that many of the bayous, lakes, and natural waterways with which the canal would connect have an available navigable depth of not exceeding 5 feet, that the waterway would probably be used by ordinary river craft of not more than 4 to 5 feet draft, and that the cost of a canal 5 feet in depth would be very materially less than that of 7 feet depth, the Board of Engineers for Rivers and Harbors believes that for the present at least a depth of 5 feet would satisfactorily serve the needs of navigation. It believes that interests involved are sufficient to justify the expenditure necessary to obtain a free waterway over this section 5 feet in depth, and it therefore reports that in its opinion it is advisable for the General Government to undertake the construction of a canal 5 feet deep and 40 feet wide at bottom, the line to follow such route as may be approved by the Secretary of War upon recommendation of the Chief of Engineers, after the price at which the existing canals can be purchased and the questions of right of way have been determined. The total cost of the canal should not exceed approximately \$826,000, whether it follows one of the existing canals or a new route, and it may be considerably less. It is recommended that the first appropriation be \$300,000, and that subsequent appropriations be made so as to complete the work in three years.

REPORT OF THE CHIEF OF ENGINEERS.

The estimates make no allowance for cost of right of way, it being believed that in most instances the advantage to the localities concerned will be sufficient to cause the communities interested in the movement and benefited thereby to furnish the right of way required free of cost to the United States; and, furthermore, the estimates are based on the assumption (as recommended by both boards) that the actual routes in detail to be adopted shall at the time of actual construction work be subject to change or modification by the War Department according to such local conditions as may then exist.

Along the entire stretch from St. Georges Sound to the Rio Grande the area adjoining the coast front is, as a rule, low, and is, in the main, occupied either by almost continuous shallow inland sounds, or by low marshy or swampy ground interspersed with numerous creeks and small channels of shallow draft, through all of which the waterway construction will be comparatively simple and inexpensive, and the route once constructed may be maintained at reasonable cost.

The Chief of Engineers believes that, as it is impracticable to improve each of the smaller rivers of the Gulf Coast to the extent of allowing to each a free access to ocean steamers, it will be very advantageous eventually to all these States to connect the lower end of these streams by an inside coastal waterway which shall afford at an early date a 5-foot draft waterway connection to all sections, and especially to the nearest ocean port.

I have, therefore, following the instructions of Congress as regards this section of the intracoastal waterway, to report that the improvement by the United States of the intracoastal route from Mississippi River to Bayou Teche is deemed advisable so far as to give a 5-foot draft continuous inland waterway, following in general the route and methods recommended in the accompanying report of the special board, at a total estimated cost of \$826,000.

CALCASIEU RIVER AND PASS, LA.

Location and description.—Calcasieu River has its source in southwestern Louisiana, and flows in a general southerly direction to the Gulf of Mexico. About 25 miles from the Gulf it debouches into

Calcasieu Lake, which lake is about 18 miles long. The connection between the lake and the Gulf, about 7 miles long, is known as Calcasieu Pass. The entire length of the stream is about 215 miles, but the portion under improvement extends from the mouth of the pass through Calcasieu Lake up the river to Philips Bluff, a distance of 97 miles.

Condition at end of fiscal year.—The project is considered to have been completed in 1906. No improvement work was carried on above Calcasieu Lake.

River: From Jones Bluff to Philips Bluff the stream is from 3 to 4 feet deep, mean low Gulf, but is badly obstructed by snags, logs, fallen and overhanging trees, and is only available for logging operations. Below Jones Bluff to Calcasieu Lake there is a wide channel, 7 to 38 feet deep.

Lake: The lower end of Calcasieu Lake was dredged at various times from 1873 to 1916, and in 1886–87, 1892–1894, and in 1906 revetments were constructed to protect channel. The bar at the upper end of Calcasieu Lake has also been dredged on numerous occasions. As present the available depth on bar at upper end of lake is 5 feet, mean low Gulf; through the lake, 6 to 6.5 feet, mean low Gulf; at lower end, 3.3 feet, mean low Gulf.

Pass: The work on the jetties was prosecuted under various appropriations between 1892 and 1905; the length of the east jetty is 8,447 feet and that of the west jetty 3,200 feet. There is now an 8-foot depth through the jetties and 12-foot depth through the pass.

The minimum depth from Lake Charles to the Gulf is 3.3 feet, mean low Gulf. To June 30, 1916, there was expended for improvement \$449,425.58; for maintenance, \$144,394.75; combined total, \$593,820.33.

Effect of improvement.—Certain special rates from New Orleans to Lake Charles and Westlake, La., on the Calcasieu River, are quoted in the tariff of the Morgan's Louisiana & Texas Railroad & Steamship Co. on account of water competition. The inhabitants of Cameron, La., and many other ridges adjoining the lower Calcasieu are entirely dependent on this improvement for intercourse with Lake Charles and other markets.

Proposed operation.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Dredging shoals in upper and lower Calcasieu Lake-----	\$5, 750. 00
Supervision and office expenses-----	868. 32
Total -----	6, 618. 32

Operations will be begun in August, 1916, and will be continued as long as plant is available.

The funds requested for fiscal year 1918 will be apportioned as follows:

Dredging shoals in upper and lower Calcasieu-----	\$2, 000
Dredging cut-off-----	2, 500
Superintendence and inspection-----	500
Total -----	5, 000

While the estimate is larger than the average expenditure for the past three years, due to lack of sufficient funds, the channel has been allowed to deteriorate, and the commerce of the stream makes it neces-

sary to restore the channel. The estimate for maintenance will be high for the next few years. The isolated locality makes the transfer of plant and equipment very expensive. The amount requested is not excessive and is considered necessary.

Local cooperation.—The cut-off referred to was made by private parties a few years ago about $2\frac{1}{2}$ miles below Lake Charles, and is now used for navigation purposes instead of the natural channel. Deeds covering the right of way of this cut-off have been donated to the United States, and it is now proposed to widen and maintain this cut-off rather than the original channel for the use of boats.

Commercial statistics.—A comparative statement of shipments and receipts for the past three years is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	709,823	\$1,978,424
1914.....	605,594	11,873,509
1915.....	852,661	13,507,995

The tonnage for the fiscal year 1915 consisted principally of logs, lumber, live stock, sand, shells, cordwood, and miscellaneous merchandise. Lumber and logs, which comprise about 92 per cent of the total tonnage, required vessels of a draft of 4 to 7 feet. Sand, which comprises about 2 per cent of the total tonnage, required vessels of a draft of 5 to 6 feet.

Amount expended on all projects from June 10, 1872, to June 30, 1916:

New work.....	\$495,913.63
Maintenance	144,394.75
Total	<u>640,308.38</u>
Balance available for fiscal year ending June 30, 1917.....	6,618.32
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	5,000.00

BOGUE FALIA, BAYOU MANCHAC, AMITE, CHEFUNCTE, AND TICKFAW
RIVERS, LA.

Prior to 1902 these streams had been improved under separate appropriations. The improvements were combined by the river and harbor act of June 13, 1902.

(A) CHEFUNCTE RIVER AND BOGUE FALIA.

Location and description.—The Chefuncte River rises in upper portions of Tangipahoa and Washington Parishes and flows southerly into Lake Pontchartrain, opposite New Orleans. The distance from New Orleans to the mouth of Chefuncte River by water via New Basin Canal is $31\frac{1}{2}$ miles. The Bogue Falia rises in the lower portion of Washington Parish and flows southerly, joining the Chefuncte River $10\frac{1}{2}$ miles above Lake Pontchartrain. The portion under improvement extends from the mouth of the Chefuncte to Covington, on the Bogue Falia, a distance of $14\frac{1}{2}$ miles.

Existing project.—The existing project provides for dredging the bar at mouth of the Chefuncte and for dredging and removing ob-

structions from the Chefuncte and Bogue Falia to Covington, La., at an estimated cost of \$5,460. In report on an examination made in 1889 (Annual Report, 1889, p. 1529), an annual maintenance of \$1,000 was recommended. The length of improvement is 14½ miles. Mean tidal variation is 10 inches at mouth and 2 or 3 inches at head. The project was adopted by the river and harbor act of March 3, 1881, and is based on report printed in House Executive Document No. 54, Forty-sixth Congress, second session (no maps).

Condition at the end of fiscal year.—The removal of wreck of the gunboat *Oregon* from the Chefuncte was performed in 1872. Obstructions have been removed from the waterway, and considerable dredging has been done at the mouth of the Chefuncte and in the Bogue Falia near Covington. A pile breakwater 820 feet long was constructed at the mouth of the Chefuncte in 1884. The project is considered completed. There is now a channel 100 feet wide and 7 feet deep at mean low gulf over the bar at mouth of the Chefuncte and in the stream as far as the Bogue Falia. On the Bogue Falia the present channel has a width of at least 60 feet and a depth of 7 feet (mean low gulf) to the head of improvement at Covington. The 7-foot depth is available throughout the year. There was expended to June 30, 1916, \$19,342.24 for improvement, \$18,805.98 for maintenance; a combined total of \$38,148.22.

Effect of improvement.—Due to water competition Covington has the advantage of reduced freight on numerous commodities between that point and New Orleans, certain rates being considerably less than to intermediate points having shorter haul.

Proposed operations.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Dredging shoals in Bogue Falia and bar at mouth of Chefuncte River	\$1, 500. 00
Removing obstructions in Chefuncte River and Bogue Falia	457. 77
Supervision and office expenses	500. 00
Total	2, 457. 77

Operations will probably be begun in May, 1917, and prosecuted continuously, if possible, until completion.

The estimate of funds for 1918 is apportioned as follows:

Dredging approximately 9,000 cubic yards, at 20 cents	\$1, 800
Supervision and office expenses	200
Total	2, 000

While the estimate is larger than the amount expended in the last three years, it is less than the expenditure for 1916. The improvement was not properly maintained during the preceding two years, and to do this the amount estimated is necessary. The increased traffic on these streams demands better channel facilities.

Commercial statistics.—A comparative statement of shipments and receipts for the past three years is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	366,323	\$2,635,000
1914.....	326,675	3,717,283
1915.....	293,298	2,048,295

The tonnage for the calendar year 1915 consisted principally of lumber, logs, brick, sand, and miscellaneous merchandise. Sand, which comprises nearly two-thirds of the total tonnage, requires vessels of from 6 to 7 foot draft, and logs and lumber, which comprise nearly one-sixth of the tonnage, require boats of a draft of 6 to 7 feet.

Amount expended on all projects from Mar. 3, 1881, to June 30, 1916:

New work	\$24,563.24
Maintenance	18,805.98
Total	43,369.22
Balance available for fiscal year ending June 30, 1917	2,457.77
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	2,000.00

(B) TICKFAW RIVER AND TRIBUTARIES, LA.

Location and description.—Tickfaw River rises in the extreme southwestern part of the State of Mississippi and flows in a southerly direction to Lake Maurepas. It is joined by the Natalbany River 2 miles above its mouth and by the Blood River $7\frac{1}{2}$ miles above its mouth. The Ponchatoula River is a tributary of the Natalbany River, joining it 4 miles above its junction with the Tickfaw.

Natalbany River flows into the Tickfaw River about 2 miles above its entrance into Lake Maurepas.

Blood River flows into the Tickfaw River about $7\frac{1}{2}$ miles above its entrance into Lake Maurepas.

Ponchatoula River flows into the Natalbany River at about $3\frac{3}{4}$ miles above its junction with the Tickfaw River.

Existing project.—The existing project provides for removal of obstructions on the Tickfaw River for 26 miles above its mouth: on the Blood River to the head of navigation, about 4 miles; and on the Natalbany and Ponchatoula Rivers, $15\frac{1}{2}$ miles; all at an estimated cost of \$10,230. Annual cost of maintenance and channel dimensions are not specified. The mean tidal variation is 10 inches. The project was adopted by the river and harbor act of March 3, 1881, and is based on report dated February 27, 1880, submitted in House Executive Document No. 54, Forty-sixth Congress, second session (Annual Report for 1880, p. 1182). A map of Tickfaw River and tributaries is published in Senate Executive Document No. 192, Forty-eighth Congress, first session.

Condition at the end of the fiscal year.—The general character of the work consisted in snagging and removing overhanging trees, thereby making navigation easier and safer. The project was completed in 1891, but the work has not been permanent. At present the head of navigation on the Tickfaw is 18 miles above its mouth; on the Natalbany, 10 miles; on the Ponchatoula, about 4 miles; and on the Blood, about 4 miles. The present available depths are as follows: Tickfaw River, mile 0 to mile 10, 7 feet, and mile 10 to mile 26, 6 feet; Natalbany River, 8 feet; Blood River, 6 feet; and Ponchatoula River, 7 feet; mile zero being at the mouth of the stream in each case. The amount expended to June 30, 1916, is \$8,115.49 for improvement and \$16,220.53 for maintenance, a combined total of \$24,336.02.

Effect of improvement.—There is no effect on freight rates from the improvement, as there are no railroads adjacent to the navigable

portions of these streams, but the general navigability has been much improved, and much larger boats are able to navigate same with safety.

Proposed operations.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Removing obstructions in the stream.....	\$2, 071. 44
Supervision and office expenses.....	500. 00
Total.....	2, 571. 44

Operations will probably be begun in May or June, 1917, and prosecuted as far as the necessity requires and the availability of plant will permit.

The funds estimated for the fiscal year 1918 will be used for removing snags and other obstructions, constantly forming.

Operation of United States snag boat.....	\$800
Supervision and office expenses.....	200
Total.....	1, 000

While the estimate is larger than the average amount expended in the last three years, it is considered necessary in view of any sudden work needed and the considerable cost of getting the plant to the site.

Commercial statistics.—A comparative statement of shipments and receipts for the past three years are as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	121, 314	\$2, 227, 763
1914.....	87, 105	1, 387, 496
1915.....	48, 516	416, 519

The decrease in commerce during the calendar year is probably attributable to unusual lumber conditions, due to the European war. The tonnage for the calendar year 1915 consisted principally of lumber, logs, laths, piling, brick, and miscellaneous merchandise. Practically all of the commerce is carried between Springfield on the Natalbany and the mouth of the Tickfaw. The draft of boats operating on the stream varies from 4 to 7 feet. Lumber and logs, comprising about 90 per cent of the total tonnage, require boats of 6 to 7 feet draft.

Amount expended on all projects from Mar. 3, 1881, to June 30, 1916:

New work.....	\$8, 115. 49
Maintenance.....	16, 220. 53
Total.....	24, 336. 02

Balance available for fiscal year ending June 30, 1917.....	2, 571. 44
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	1, 000. 00

(C) AMITE RIVER AND BAYOU MANCHAC, LA.

Location and description.—The Amite River has its headwaters in the State of Mississippi, flows in a generally southerly direction,

and empties into Lake Maurepas. It is joined by Bayou Manchac about $35\frac{3}{4}$ miles above Lake Maurepas.

Bayou Manchac extends from near the Mississippi River eastwardly to Amite River and is $18\frac{3}{4}$ miles long.

Existing project.—The existing project was adopted in 1880 and provided for the removal of obstructions such as snags, trees, etc., from the mouth of the Amite River to $73\frac{1}{2}$ miles above its junction with Bayou Manchac, a total distance of 110 miles; and the concentration of the channel by the closure of island chutes; all at an estimated cost of \$23,760. The project is based on report dated February 27, 1880, and printed in House Executive Document No. 54, Forty-sixth Congress, second session. In 1888 the improvement of Bayou Manchac was added, the initial appropriation being made by the river and harbor act of August 11, 1888, which appropriated \$5,000 for the Amite River and stipulated that \$2,500 might be used in improving Bayou Manchac. The dredging of a turning basin for boats at or near the mouth of Wards Creek was authorized by Congress in 1892. Annual estimate of cost of maintenance and channel dimensions are not specified. The mean tidal variation is about 10 inches.

Condition at the end of fiscal year.—Considerable snagging and dredging work has been carried on in the Amite River since 1881, from 40 miles above Bayou Manchac to Lake Maurepas, nearly all of which was below the mouth of Bayou Manchac. Bayou Manchac has been improved since 1888 from mouth to Wards Creek by snagging and dredging. The project has been considered completed since 1891. None of the work accomplished was of a permanent nature. The bars require annual dredging, while lumbering operations and the character of banks cause the need of snagging work. The Amite River from its mouth to Bayou Manchac is now in good condition, and Bayou Manchac from mouth to Wards Creek has a good navigable channel. The maximum draft that can be carried at all times on the Amite River is 7 feet for 36 miles from mouth at Lake Maurepas and 3 feet for the next 5 miles. On Bayou Manchac, 8 miles from mouth to Wards Creek, the maximum draft that can be carried is 7 feet. All depths refer to mean low Gulf. The amount expended to June 30, 1916, is \$24,900.82 for improvement and \$40,524.52 for maintenance, a combined total of \$65,425.34.

Effect of the improvement.—There is no definite data as to the effect of the improvement on freight rates, as the territory adjacent to navigable portions of these streams is practically without railroads. However, the improvement has resulted in a safer and better means of water transportation on both streams, serving a territory practically not reached by any railroads.

Proposed operations.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Removing obstructions on Amite River and Bayou Manchac-----	\$1,000.00
Dredging shoals at mouth of Bayou Manchac-----	800.00
Supervision and office expenses-----	378.67
Total-----	2,178.67

Operations will probably be begun in April, 1917, and prosecuted continuously, if possible, until completion.

Funds estimated for the fiscal year 1918 will be used for maintenance of the streams, as follows:

Operation of combined dredge and snag boat.....	\$2, 600
Supervision and inspection.....	400
Total.....	3, 000

While the estimate is larger than the average amount expended in the last three years, it is less than the amount expended in 1916. The improvement was not properly maintained during the previous two years. To properly maintain the channel, as increase of traffic between Hope Villa and New Orleans demands, the amount estimated is considered necessary.

Commercial statistics.—A comparative statement of shipments and receipts for the past three years is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	46,608	\$1,112,105
1914.....	36,079	1,312,272
1915.....	100,772	1,367,075

The tonnage for the calendar year 1915 consisted principally of cordwood, lumber, logs, hay, and miscellaneous merchandise on the Amite River. The logs are towed from all points along the stream to the various mills close to the Amite River, Tickfaw River and tributaries, and Chefuncte River. Above Bayou Manchac logging is the only traffic. On Bayou Manchac there is no regular traffic owing to the difficulty, it is claimed, in navigating boats over the bar at the mouth of Bayou Manchac and on account of snags. With the revival of cotton raising and a good open channel, boat travel will probably become regular on the Manchac. Logs and lumber, comprising practically 93 per cent of all traffic, require boats drawing from 6 to 7 feet of water.

Amount expended on all projects from 1880 to June 30, 1916:

New work	\$24, 900. 82
Maintenance	40, 524. 52
Total.....	65, 425. 34

Balance available for fiscal year ending June 30, 1917..... 2, 178. 67

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 3, 000. 00

CONSOLIDATED.

Amount expended on all projects from 1880 to June 30, 1916:

New work	\$57, 579. 55
Maintenance	75, 551. 03
Total.....	133, 130. 58

Balance available for fiscal year ending June 30, 1917..... 7, 207. 88

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 6, 000.00

PONTCHARTRAIN LAKE, LA.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 176, Sixty-third Congress, first session:

Lake Pontchartrain is a shallow, fresh-water lake, lying north of the city of New Orleans, La. The lake is about 40 miles long and 24 miles wide, and has a general depth of about 15 feet. It is connected with Lake Borgne, and thence with the Mississippi River and the Gulf of Mexico by two deep passes—the Rigolets and Chef Menteur Pass. Between these passes and the main portion of Lake Pontchartrain a region of shallow water exists, varying in width from 1 to 2 miles and in depth from 3 to 6 feet. This shoal is known as the "Middle Grounds" and determines the maximum draft that can be carried between Lake Pontchartrain and Lake Borgne. The available depth is insufficient for the vessels navigating these waters, and considerable delay and inconvenience have been occasioned thereby. The district officer is of opinion that the locality is worthy of improvement by the United States, and he submits a plan providing for a channel 8 feet deep at mean low water and 150 feet bottom width via route A-B. No protection works are recommended at the present time, but he states that the channel should be marked by beacons or guide piles. The estimated cost of the improvement, including these channel marks, is \$32,000. The division engineer concurs in the favorable views of the district officer.

I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore in carrying out the instructions of Congress I report as follows: That the improvement by the United States of Lake Pontchartrain, La., with a view to the removal of the middle ground between the Rigolets and the north draw of the New Orleans & Northeastern Railroad bridge, is deemed advisable so far as to secure an available channel depth of 8 feet and a channel width of 150 feet increased at entrances and on curves, approximately on the line A-B indicated on the accompanying map, following in general the methods described in the report of the district officer, at an estimated cost of \$32,000 for first construction and \$3,200 annually for maintenance.

BAYOU VERMILION, MERMENTAU RIVER, AND BAYOU PLAQUEMINE
BRULÉ, LA.

Prior to 1902 these streams had been improved under separate appropriations. The improvements were combined under river and harbor act of June 13, 1902.

(A) CHANNEL, BAY, AND PASSES OF BAYOU VERMILION, LA.

Location and description.—Vermilion River is formed by the junction of Bayous Fusilier and Bourbeau, west of Arnaudville, La., and flows in a general southwesterly direction, emptying into the western end of Vermilion Bay. The length of the entire stream is about 71 miles, that of the section under improvement being 51 miles and extending from near Lafayette, La., to Vermilion Bay.

Condition at the end of fiscal year.—The general character of work has consisted in snagging and dredging. A brush jetty (650 feet long), to partly close the eastern entrance at mouth, was constructed in 1881–1883. The bar at mouth has needed considerable dredging. The existing project is considered completed, but none of the work has been permanent. The present controlling depths are: Over bar at mouth, 3 to 4 feet; mouth (mile 0) to mile 31, 7.9 to 26 feet; mile 31 to mile 42, 5 to 14 feet; mile 42 to mile 51, 1.4 to 14 feet, mile zero being at mouth of stream. There have been

expended on the existing project to June 30, 1917, \$25,000 for improvement and \$31,839.66 for maintenance, a combined total of \$56,839.66.

Effect of improvement.—Navigation has been rendered easier and a deeper channel has generally been maintained. The freight rates at Abbeville are affected by this water competition, and it is proposed to establish a barge service to New Orleans.

Proposed operation.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Dredging shoals at mouth into Vermilion Bay	\$4,500.00
Supervision and office expenses	651.75
Total	5,151.75

Operations will probably be begun in September, 1916, and prosecuted continuously until completion, provided plant is available.

The amount requested for the fiscal year 1918 will be used as follows:

Dredging at mouth and through shoals in upper section	\$3,500
Superintendence and inspection	500
Total	4,000

While the estimate is larger than the average amount expended in the last three years, due to lack of funds, the channel has been allowed to deteriorate considerably. The towing of cane on this stream demands that the channel be kept open, not only over the section previously improved but farther upstream, but within the limits of the project, and in order to do this the estimate is considered necessary.

Commercial statistics.—A comparative statement of shipments and receipts for the past three years is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	35,369	\$287,670
1914.....	27,915	282,362
1915.....	21,208	268,704

The tonnage for the calendar year 1915 consisted principally of sugar cane, fuel oil, wood, and miscellaneous merchandise. Sugar cane and fuel oil, which comprise about 85 per cent of the total tonnage, required vessels of a draft of 4 feet 6 inches; miscellaneous products were carried in boats of a draft of 3 feet 6 inches to 4 feet.

Amount expended on all projects, 1880 to June 30, 1916:

New work	\$34,900.00
Maintenance	31,839.66
Total	66,739.66

Balance available for fiscal year ending June 30, 1917	5,151.75
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	4,000.00

Letter from the Chief of Engineers submitting estimate for maintenance of Vermilion River, La., December 20, 1916:

In response to your request of the 19th instant, I have the honor to submit herewith an estimate of the amount required for restoration to a depth of 5 feet of the channel in Vermilion River, La., from the mouth to Pinhook Bridge, a short distance below the town of Lafayette:

Dredging the bar at the mouth:

For a channel 5 by 100 feet, approximately 4,000 linear feet, 24,000 cubic yards, at 15 cents-----	\$3, 600
Ten dolphins, at \$50-----	500

Mile 0 to mile 31:

For a channel 5 by 60 feet, no work except a little snagging-----	500
---	-----

Mile 31 to mile 41:

For a channel 5 by 40 feet, 9,000 cubic yards, at 15 cents-----	1, 350
Snagging -----	2, 000

Mile 41 to mile 49:

For a channel 5 by 40 feet, 160,000 cubic yards, at 15 cents-----	24, 000
Snagging -----	4, 500

Contingencies -----	3, 550
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Total-----	40, 000
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Annual maintenance-----	4, 000
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(B) MERMENTAU RIVER AND TRIBUTARIES, LA.

Location and description.—The Mermentau River is formed by the junction of Bayou Des Cannes and Nezpique, 2¼ miles above Mermentau, La., and flowing in a southwesterly direction, empties into the Gulf of Mexico. The length of the stream is 71½ miles. The entire Mermentau River and 25 miles of Bayou Nezpique are included in this improvement.

Existing project.—The existing project provides for the removal of obstructions to navigation to secure the natural channel throughout the entire Mermentau River and through Bayou Nezpique from its mouth to 25 miles above; also for improving the channel in Lower Mud Lake by constructing a brush dam to concentrate the action of the current and by dredging; all at an estimated cost of \$23,615.25. The mean tidal variation of Mermentau River is about 10 inches at the mouth and about 2 or 3 inches at the head. The project was adopted in 1892, and is based on report (no maps) printed in Annual Report for 1891, page 1862. The river and harbor act approved July 27, 1916, provided that of the appropriation therein made the sum of \$1,500, or so much thereof as may be necessary, may be expended in removing the wrecked lock and dam near the mouth of the Mermentau River. (H. Doc. No. 1232, 64th Cong., 1st sess.)

Condition at the end of fiscal year.—Since 1892 obstructions have been removed from the Mermentau and the Nezpique. Considerable dredging has been done in Lower Mud Lake, and in 1897–98 two pile and brush dams, 2,500 feet and 3,000 feet long, were constructed. The project was considered completed in the fiscal year 1900, but the work has not been permanent. The depths available throughout the year were: Over bar at mouth, 3 feet; mile 0 to mile 36, 3 feet; mile 36 to mile 71.5, over 6 feet, mile zero being at mouth of stream. There have been expended to June 30, 1917, \$26,115.25 for improvement and \$12,759.88 for maintenance, a combined total of \$38,875.13.

Effect of improvement.—No railroad has penetrated the section bordering the lower 53 miles of the river, consequently the improvement has facilitated traffic and transportation, which are practically dependent on the stream. On account of the location of the town of Mermentau on the upper Mermentau that town has on certain articles rail rates lower than those of intermediate points.

Proposed operations.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Dredging shoals in Lower Mud Lake and removing obstructions throughout the stream and tributary-----	\$7, 441. 00
Removing dam near mouth-----	1, 000. 00
Supervision and office expenses-----	826. 92
Total -----	9, 267. 92

Operations will probably be begun in November, 1916, and prosecuted continuously until completion, if possible.

The estimate for the fiscal year 1918 will, therefore, be expended in the maintenance of the channel in the lakes and for removing snags and other obstructions, as follows:

Operations of United States dredge and snag boat-----	\$2, 700
Inspection, superintendence, etc -----	300
Total -----	3, 000

While the estimate is larger than the average amount expended in the last three years, due to lack of funds and plant, this improvement has been allowed to deteriorate. The amount requested is not excessive and is considered necessary.

Commercial statistics.—A comparative statement of shipments and receipts for the past three years is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	34,982	\$642,448
1914.....	26,432	548,186
1915.....	24,535	961,785

The tonnage for the calendar year 1915 consisted principally of fuel oil, logs, lumber, rice, coal, and miscellaneous merchandise. Fuel oil, rice, and miscellaneous merchandise, which comprise practically two-thirds of the total tonnage, required vessels of 5 to 6 foot draft. Coal, lumber, and logs, which comprise nearly one-third of the total tonnage, required vessels of 4 to 6 foot draft.

Amount expended on all projects from July 13, 1892, to June 30, 1916:	
New work-----	\$26, 115. 25
Maintenance-----	12, 759. 88
Total-----	38, 875. 13
Balance available for fiscal year ending June 30, 1917-----	9, 267. 92
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	3, 000. 00

(C) BAYOU DES CANNES, LA.

Proposed operations.—None.

(D) BAYOU PLAQUEMINE BRULÉ, LA.

Location and description.—Bayou Plaquemine Brulé rises in the southwestern part of St. Landry Parish and flows in a general southwesterly direction, entering Mermentau River about 5 miles above Mermentau, La. It is about 75 miles long. The section under improvement is from mouth to near Crowley, La., a distance of about 19 miles.

Existing project.—The existing project provides for the removal of snags, logs, and other obstructions, and for dredging to obtain a clear channel of 60-foot bottom width and a depth of 6 feet at mean low Gulf, beginning at the mouth of the bayou and extending to a point near the town of Crowley, La., a distance of about 19 miles. The estimated cost of the work involved was \$10,000 with \$250 annually for maintenance. The mean tidal variation at mouth is 2 or 3 inches with no perceptible variation at head. The project was adopted by the river and harbor act of June 25, 1910, and is based on report printed in House Document No. 789, Sixtieth Congress, first session.

Condition at the end of the fiscal year.—A channel 6 feet deep at mean low Gulf and 60 feet wide has been secured for 19 miles from the mouth to near Crowley, La., by dredging and removing obstructions. The existing project was completed in 1915, affording a 6-foot depth throughout the year. To June 30, 1916, there was expended \$32,807.10 for improvement and \$1,691.20 for maintenance, a total of \$34,498.30.

Local cooperation.—There was no local cooperation imposed by law. Right of way was furnished for cut-off free of cost to the United States and accepted by the Government March 9, 1915.

Effect of improvement.—Obstructions have been removed, channel deepened, and navigation made possible under the project section, enabling better facilities for transportation of material over the bayou.

Proposed operations.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Removing snags, fallen and overhanging trees.....	\$3, 000. 00
Supervision and office expenses.....	548. 90
Total	3, 548. 90

Operations will probably be begun in December, 1916, and prosecuted continuously until completion, dependent upon availability of the plant.

The estimate of funds for the fiscal year 1918 is apportioned as follows:

Removing snags, fallen and overhanging trees.....	\$1, 800
Supervision and office expenses.....	200
Total	2, 000

This improvement has recently been completed, and the stream is narrow, extremely crooked and heavily timbered, and the frequent cyclones which visit this section cause these trees to fall into the bayou, and the sluggish currents cause drift to form, blocking off the bayou completely. The isolated locality makes the taking of the plant to the site and the work very expensive, and for these reasons the estimate is not excessive and is considered necessary.

Recommended modifications of project.—None.

Commercial statistics.—A comparative statement of shipments and receipts for the past three years is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	14,150	\$68,850
1914.....	10,650	202,250
1915.....	7,916	154,753

The usual limits of draft for loaded vessels varied from 3 feet 6 inches to 6 feet. Logs and lumber, which comprise about 85 per cent of the total tonnage, required vessels of 4 to 6 foot draft, while fuel oil, which comprises about 14 per cent of the total tonnage, required vessels of 5 to 6 foot draft. Miscellaneous merchandise required vessels of 4 to 6 foot draft.

Amount expended on all projects from June 25, 1910, to June 30, 1916:

New work.....	\$32,807. 10
Maintenance	1,691. 20
Total.....	34,498. 30

Balance available for fiscal year ending June 30, 1917..... 3,548. 90

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 2,000. 00

CONSOLIDATED.

Amount expended on all projects from 1880 to June 30, 1916:

New work.....	\$93,822. 35
Maintenance	46,790. 74
Total.....	140,613. 09

Balance available for fiscal year ending June 30, 1917..... 17,968. 57

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 9,000. 00

REMOVING THE WATER HYACINTH—MISSISSIPPI, LOUISIANA, AND TEXAS.

The water hyacinth is a floating plant which infests the waters of the Gulf coast, increasing with great rapidity during the summer season and being cut down to water level by frost in winter. It greatly obstructs the navigable waters, and is propagated not only by seed but by development of new plants from the root stems or portions of the root. It made its appearance in the waters of southern Louisiana about 1884 and spread with such rapidity that it soon infested all the streams without sufficient current to carry it to salt water.

Existing project.—Existing project for destruction of these plants is based on report printed in House Document No. 91, Fifty-fifth Congress, third session, and provides for construction and operation of boats equipped with suitable machinery for removing and crushing the plants and the use of log booms for preventing the plants drifting from one stream into another. Estimated cost, \$25,000 for boat, \$10,000 for operation, and \$1,000 for establishment of log booms; total of \$36,000. The river and harbor act of June 13, 1902, authorized use of mechanical, chemical, or other means whatsoever for the extermination of the plant, and under this provision the project was modified so as to destroy the plants by chemicals instead of mechanical means. The river and harbor act of July 25, 1912, made the appropriation available to include the removing of water hyacinths from the navigable waters of the State of Mississippi.

Condition at the end of fiscal year.—From 1900 to 1902, a boat with suitable machinery for removing and crushing the hyacinth was operated. Since then the U. S. steamer *Hyacinth*, equipped with means for spraying plants with a solution of arsenic and soda has been used in these streams whose commercial importance justified improvement. Booms have been constructed at certain points to prevent the drifting of the plant from nonnavigable streams into those which are navigable. The principal streams in the State have been kept almost entirely free from plants, resulting in a great benefit to navigation. In 1915 spraying barge *No. 1* was equipped for spraying the smaller streams. To June 30, 1916, there was expended for maintenance \$225,873.77.

Local cooperation.—No reasonable amount of money can hold the water hyacinth in check without the cooperation of local officers and private parties. Plan for such cooperation, whereby the United States has performed the heavier work of removal, established booms and employed boom tenders where necessary, and interested officials and parties have maintained patrols to keep the streams free, was inaugurated during 1912. By this cooperation navigation in Bayous Black, Teche, Vermilion, Des Allemands, Leau Bleu, and others of the worst obstructed streams of the State has been greatly benefited.

Effect of improvement.—The clearing of the streams of water hyacinths makes navigation possible on many streams and in others materially assists in easy navigation.

Proposed operations.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Operation of U. S. S. <i>Hyacinth</i> and spraying barge <i>No. 1</i> -----	\$18,435.75
Supervision and office expenses-----	5,000.00
Total-----	23,435.75

The amount requested for fiscal year 1918 will be apportioned as follows:

Operation of U. S. S. <i>Hyacinth</i> and spraying barge-----	\$18,000
Superintendence and supervision-----	2,000
Total-----	20,000

While the estimate is larger than the average expenditure for the past three years, the hyacinths are becoming more numerous and it is harder to eradicate them. An additional outfit has been neces-

sary and has been placed on the work of extermination of the plant, which adds to the cost of operations. The one boat used for this purpose is getting old and requires heavy repair charges each year. The old booms are being repaired and stronger and more substantial ones are being used. The amount requested is not excessive, is considered necessary, and is the same as has been made annually for the two past years.

Amount expended on all projects from June 13, 1902, to June 30, 1916:

New work-----	
Maintenance -----	\$225, 873. 77
Balance available for fiscal year ending June 30, 1917-----	23, 435. 75
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	20, 000. 00

BAYOU TERREBONNE, LA.

Location and description.—Bayou Terrebonne has its headwaters in Lafourche Parish, near Thibodaux, La., and flows in a southerly direction, emptying into Terrebonne Bay. The length of the stream is 53 miles. Below Houma, La., which is 37 miles from mouth, the stream has surface widths varying from 50 to 200 feet.

Existing project.—The existing project provides for improving the stream from Houma, La., to deep water (Bush Canal, 24.11 miles), by dredging a channel 6 feet deep at mean low Gulf with a suitable width, at an estimated cost of \$50,000. The estimated cost was subsequently increased to \$75,000. The distance from the Bush Canal to the mouth of Bayou Terrebonne is 12.9 miles. The project was adopted by the river and harbor act of June 25, 1910, based on report (with map) submitted in House Document No. 1163, Sixtieth Congress, second session. The mean tidal variation at mouth is 10 inches; at Houma, 4 inches.

Condition at the end of fiscal year.—Under previous and existing projects considerable dredging and snagging work has been carried on from Houma to the Bush Canal (24.11 miles below), at which point is found the 6-foot channel. The existing project was completed during the fiscal year 1916, and there was available throughout the year a channel 6 feet deep at mean low Gulf and 45 feet wide from the head of improvement (which is at the St. Louis Cypress Co.'s bridge at Houma) to mile 2.93, and a channel 6 feet deep and 50 feet wide from mile 2.93 to mile 24.11. The total amount expended to June 30, 1916, is \$73,069.49, all for new work.

Local cooperation.—Under the terms of the appropriating clause, Congress provided that no portion of the appropriation shall be expended until title to any land required for the purpose of this improvement shall have been deeded to the United States free of cost. The river and harbor act approved July 25, 1912, amended this provision by providing that the right of way for the additional width required for excavation and for depositing dredged material shall be given by local interests free of cost to the United States. The river and harbor act of March 4, 1913, further changed the proviso, so that the present requirement is that no expense shall be incurred by the United States for acquiring any lands required for the purpose of improvement. Easement was willingly granted by the riparian landowners without any cost to the United States.

Effect of improvement.—Free and easy navigation has been given to the present bayou traffic, and the development of commerce should follow.

Proposed operations.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Dredging and removing obstructions	\$4, 000. 00
Supervision and office expenses	975. 12
Total	4, 975. 12

Operations will probably be begun after January, 1917, and prosecuted continuously, if possible, until completion.

Funds estimated for the fiscal year 1918 will be used for maintenance of the stated channel, as follows:

Removing snags, shoals, and debris caused by storms	\$2, 700
General supervision	300
Total	3, 000

The improvement of this stream has just been completed and the maintenance will probably be rather high for the next few years, due to caving banks, until equilibrium has been established. The expense of transferring a dredge to this work is high, and it is believed that the amount estimated, with the funds on hand, to maintain this stream during that period is necessary.

Commercial statistics.—A comparative statement of shipments and receipts for the past three years is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	152, 192	\$4, 245, 188
1914.....	153, 195	3, 758, 014
1915.....	174, 446	4, 552, 458

The tonnage for the calendar year 1915 consisted principally of logs, sugar cane, sugar, fuel oil, molasses, ground and grain feed, oysters, and miscellaneous merchandise. Logs and lumber, which comprise about 44 per cent of the total tonnage, require boats of a draft of 3 to 5 feet. Sugar, which comprises about 22 per cent of the total tonnage, requires boats of a draft of 3 feet 6 inches.

Amount expended on all projects from June 14, 1880, to June 30, 1916:

New work	\$120, 133. 32
Maintenance	

Balance available for fiscal year ending June 30, 1917	4, 975. 12
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	3, 000. 00

ATCHAFALAYA RIVER, FROM MORGAN CITY, LA., TO THE GULF OF MEXICO.

Location and description.—The Atchafalaya River is an outlet of the Mississippi as well as of the Red River. It begins at Old River, on the northern boundary of Pointe Coupee Parish, and flows generally south a distance of about 170 miles and empties into Atcha-

falaya Bay, an inlet of the Gulf of Mexico. The section under improvement is from the 20-foot contour, 4 miles beyond the mouth of the Atchafalaya River, to the 20-foot contour in the Gulf of Mexico, a distance of about $15\frac{3}{4}$ miles.

Existing project.—The existing project, adopted by river and harbor act of June 25, 1910, contemplates securing a channel 200 feet wide on bottom and 20 feet deep at mean low Gulf from the 20-foot contour, 4 miles beyond the mouth of the Atchafalaya River to the 20-foot contour in the Gulf of Mexico, a distance of about $15\frac{3}{4}$ miles, and its maintenance for a period of three years at an estimated cost of \$530,000, and \$10,000 for inspections, superintendence, etc., by the United States. See H. Doc. No. 669, 61st Cong., 2d sess.) The latest published map accompanies House Document No. 410, Fifty-sixth Congress, first session. The mean tidal variation is 10 inches, and the plane of reference is mean low Gulf.

Condition at the end of fiscal year.—The minimum depth had been increased from 7 to 20 feet, at the expiration, on November 17, 1914, of the agreement for the purchase and three years' maintenance of the channel by the Atchafalaya Bay Ship Channel Co. The channel shoaled rapidly, however, and was redredged in the fiscal year 1915 by the U. S. dredge *Gulfport*. There is now a minimum depth of $11\frac{1}{2}$ feet at mean low Gulf, about mile 9.1. There were expended to June 30, 1916, \$501,963.23 for improvement and \$65,054.78 for maintenance, a combined total of \$567,018.01.

Effect of improvement.—The improvement has resulted in enabling deeper draft vessels to enter the Atchafalaya River, and has also resulted in a substantial reduction in freight rates between Morgan City and eastern ports on certain commodities; schooners carry lumber at considerably less than the all rail, or the combined rail and water rates.

Proposed operations.—It is estimated that the amount that should be applied to work of maintenance to June 30, 1918, is about \$82,700, this requiring an additional appropriation of \$30,000, and an estimate for this sum is submitted.

Commercial statistics.—Comparative statements of shipments and receipts for the past three years are as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	29,427	\$249,635
1914.....	66,147	1,553,619
1915.....	39,561	500,952

The decrease in commerce through the Atchafalaya Bay Ship Channel is probably due to channel conditions. The storm of September, 1915, practically obliterated the channel which was completed in August of that year, and there were no funds available for its restoration. This probable cause of decrease is confirmed by the statement of receipts at Morgan City, which shows an increase for the calendar year.

The tonnage for the calendar year 1915 consisted principally of lumber, fuel oil, and miscellaneous merchandise. Lumber, which

comprised about 64 per cent, was carried in schooners with a draft of about 17 feet, and fuel oil required vessels with a draft of about 11 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	695,490	\$4,268,655
1914.....	653,183	13,258,877
1915.....	666,086	10,913,403

The tonnage for the calendar year 1915 consisted principally of lumber, logs, gravel, fuel oil, sugar cane, fertilizer, and miscellaneous merchandise. The towing of logs comprises about 81 per cent of the total tonnage and required vessels of a draft of 4 to 7 feet. Lumber, which comprised about 4 per cent of the total tonnage, required vessels of a draft of 17 feet, and oil, which comprised approximately 5 per cent of the total tonnage, required vessels of a draft of 11 feet.

Amount expended on all projects from June 25, 1910, to June 30,

1916:

New work.....	\$501,963.23
Maintenance	65,054.78
Total.....	567,018.01

Balance available for fiscal year ending June 30, 1917..... 52,727.15

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 30,000.00

BAYOU GROSSETETE, LA.

Location and description.—Bayou Grossetete rises in Pointe Coupee Parish, La., and extends in a generally southeastern direction, entering Bayou Plaquemine 8 miles below Plaquemine Lock. The length of the stream is about 40 miles and the length of the section under improvement is 29 miles, extending from the mouth to 5 miles above Maringouin, La.

Existing project.—The existing project provides for improving the stream for a distance of 29 miles, from its mouth to a point about 5 miles above Maringouin, by removing snags and trees and by dredging a channel 60 feet wide on bottom and 5 feet deep at mean low water, at an estimated cost of \$18,000 for improvement and \$500 annually for maintenance. The estimated cost was later increased to \$30,000. Mean low water is about 2 feet above mean low Gulf level. The project was adopted by the river and harbor act of July 25, 1912, based on report submitted in House Document No. 348, Sixty-second Congress, second session (no maps). Mean tidal variation at mouth is 5 inches; at upper end of improvement, practically nothing.

Condition at the end of fiscal year.—The general character of the work consisted in dredging, snagging, and removing overhanging trees, and there was secured a channel 5 feet deep at mean low water and 60 feet wide from the mouth to mile 10.3 (completed in 1914), and a channel 5 feet deep at low water and 40 feet wide from mile 10.3 to mile 29 (completed in 1916). These channels were available

throughout the entire year. The project for a channel 5 feet deep and 60 feet wide for the whole length of improvement is now 60 per cent completed. To date \$29,543.75 has been spent, but the full project width has not been obtained, as the present interests of traffic do not require it.

Effect of improvement.—The stream has been cleared of its greatest hindrances to navigation, namely, shoals, snags, and overhanging trees, which prevented traffic at low stage of water. It is now possible for the bayou craft to operate for 29 miles at all seasons of the year. The barging of cane which occurred at low-water period will be greatly increased and extended to points on the upper Grossetete. Other products can be brought to market more easily, and the towage of lumber will be uninterrupted. The through channel having just been opened, no direct effect on railroad rates has been noticed.

Proposed operations.—It is proposed to expend the funds available for the fiscal year ending June 30, 1917, as follows:

Dredging and removing obstructions.....	\$4, 200. 00
Supervision and office expenses.....	975. 36
Total.....	5, 175. 36

The funds estimated for the fiscal year 1918 will be used for maintenance of a channel 5 feet deep and 40 feet wide:

Removing snags, fallen and overhanging trees.....	\$800
Supervision and office expenses.....	200
Total.....	1, 000

The maintenance will be rather high for several years, due to caving of the high, steep banks and many trees. Since the excavation of the channel and the loading of the banks with the dredged material, considerable caving will probably result. It is believed that the estimate proposed for 1918, with the balance on hand, will be sufficient to maintain the stream during this period.

Commercial statistics.—A comparative statement of shipments and receipts for the past three years is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	195, 418	\$897, 820
1914.....	127, 646	2, 565, 511
1915.....	174, 314	2, 643, 956

The tonnage for the calendar year 1915 consisted principally of lumber, logs, staves, gravel, and miscellaneous merchandise. Lumber and logs, which comprise about 92 per cent of the total tonnage, required vessels of 4 to 5 foot draft. Gravel, which comprise about 3 per cent of the total tonnage, requires vessels of 5-foot draft.

Amount expended on all projects from July 25, 1912, to June 30, 1916:	
New work.....	\$29, 543. 75
Maintenance.....	
Balance available for fiscal year ending June 30, 1917.....	5, 175. 36
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	1, 000. 00

RED RIVER BELOW FULTON, ARK.

Location and description.—Red River rises in northwestern Texas and flows in a general easterly direction, forming the boundary between Texas and Oklahoma and Arkansas. It then flows in a general southeasterly direction through Arkansas and Louisiana and enters Mississippi River at Red River Landing, La. The river is about 1,275 miles long. The river is an alluvial stream, heavily charged with sandy sediment and carrying much drift from rapidly caving banks. It has a drainage area of about 66,000 square miles.

Existing project.—This project, based on report of Capt. J. H. Willard, Corps of Engineers (Annual Report for 1890, p. 1829, and for 1891, p. 1957), was adopted by the river and harbor act of July 13, 1892, and provides for continuing improvement of Red River from Fulton, Ark., to the Atchafalaya River, 475 miles, by systematic clearing of the banks, snagging, dredging shoals, building levees (either alone or in cooperation with riparian States), closing outlets, revetting caving banks, and preventing injurious cut-offs. The lower end of the section included in the project is 6.6 miles above the mouth of the river. No proposed channel dimensions were given. As the work is continuous, no estimate for completion could be given. The estimated cost of maintenance of the improvement is \$100,000 a year, exclusive of cost of new plant when required. A map of the stream was published in the Annual Report for 1913, page 2336.

Conditions at the end of fiscal year.—The work done consisted in removing the great raft which filled the river at intervals for 92 miles, destroying a ledge of rock across the stream at Alexandria, La., closing a number of outlets which depleted the channel, constructing levees in cooperation with local levee boards, revetting caving banks where practicable, removing snags and logs from the channel, and cutting leaning trees along the banks. The work has converted a previously impassable waterway into a broad, deep river, safe for navigation at all but the lowest stages: has lowered the bottom in places as much as 25 feet and reclaimed many thousands of acres of fertile land previously covered by water. When gauge readings are 6 feet or more, which usually occurs between December and July, boats drawing 6 feet have little trouble in navigating the section included in the project. During the remainder of the year gauge readings near zero may be expected with minimum depths of 5 feet in the lower, 3 feet in the middle, and 2 feet in the upper part of this section. Work in progress is maintenance and no statement of what remains to be done can be made. The expenditures under the existing project to June 30, 1916, were \$1,265,347.24 for new work and for maintenance. It is not practicable to separate these items.

Local cooperation.—No conditions have been imposed by law. A levee was built during the year to close a crevasse in Lafayette County near Garland, Ark. The Red River levee district No. 1 contributed \$22,500 and the United States \$6,000 of the funds required.

Effect of improvement.—The work done has rendered transportation by water much easier and safer and has reduced freight rates about 33½ per cent.

Proposed operations.—It is proposed to expend \$73,982 of the funds available for the fiscal year ending June 30, 1917, in maintenance of the improvement, and \$8,239.16 in repairing levees on upper

Red River, if the required local cooperation is obtained. The funds for maintenance will be used to operate the U. S. snag boat *Howell* during the entire fiscal year, at a cost of about \$25,000, and to operate two chopping parties for about six months during low water, at a cost of about \$9,000 each, for removing obstructions from the channel and leaning trees from the banks; to use the dredge *Waterway* for about two months during low water in deepening the channel at shoal places, at a cost of about \$5,000; to rebuild the hull of the snag boat *Columbia*; and to care for all plant and make necessary repairs. The available funds will probably be exhausted before June 30, 1917.

The appropriation of \$55,000 for continuing the work of snagging and removing obstructions during the year ending June 30, 1918, is recommended. Many obstructions have been brought into the river which should be removed if it is to be kept open for navigation. A transportation company has been organized to operate a line of boats on this river below Shreveport, and it proposes to begin regular trips in the near future.

Commercial statistics.—All commerce on the stream is directly benefited by its improvement. Statistics have been compiled for the fiscal instead of the calendar year because the former more nearly coincides with the commercial year and the period of navigation ordinarily closes in June.

Comparative statement.

Fiscal year ending June 30—	Short tons.	Value.
1914.....	26, 166	\$310, 333
1915.....	47, 351	2, 939, 073
1916.....	27, 325	1, 895, 867

The freight carried during the current fiscal year consisted of lumber and logs, farm products, and general merchandise.

CONSOLIDATED.

Amount expended on all projects from May 23, 1828, to June 30, 1916:	
New work-----	} \$2, 819, 224. 74
Maintenance-----	
	<hr/> <hr/>
Balance available for fiscal year ending June 30, 1917-----	82, 221. 16
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	55, 000. 00

SABINE RIVER UP TO LOGANSFORT, LA.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document No. 668, Sixty-third Congress, second session:

The existing project for improvement of Sabine River contemplates securing a canal 25 feet deep and 150 feet wide up to the town of Orange, which is situated 13 miles above the mouth. Logansport, the upper limit of the present examination, is about 292 miles above the mouth. The district officer states that above mile 100 practical all-year navigation can be secured only by locks and dams. Open-channel improvement below about mile 130 is probably practicable to give a navigable channel for boats of about 3 feet draft from about December to July, inclusive, and improvement below mile 70 is probably practicable

to give a navigable channel for draft of 3 feet for the entire year. The district officer is of opinion that the cost of improvement by any suitable method would be excessive, and he expresses the opinion that this river is not worthy of further improvement at this time. In this opinion the division engineer concurs.

This report has been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its accompanying report, dated December 16, 1913. The board states that this river is very greatly obstructed by logs, snags, etc., the removal of which would undoubtedly be expensive and out of reasonable proportion to the resulting benefits if the cost were entirely borne by the United States. If, however, the United States can be reimbursed by the sale of logs removed from the bed of the stream in the progress of the improvement, it believes that the cost might come within reasonable limits. The board recommends "that Congress enact such legislation as may be necessary to provide that all sunken logs and timber taken by the United States, after due notice, from any river bed in the process of clearing it for navigation shall become the property of the United States, subject to sale, and that the proceeds of sale shall go to the credit of the improvement." Contingent upon such legislation, the board recommends that an appropriation of \$30,000 be made for the construction of a suitable snag boat and its operation for a period of one year on the Sabine River, and that the work of clearing the river continue thereafter so long as sufficient revenue is derived from the sale of logs to pay for the operation of the plant. While estimates of cost are not ordinarily presented in reports on preliminary examinations, the estimate given by the board is entirely for plant and its operation, no survey or other investigation being required to determine the probable expenditure required.

After due consideration of the above-mentioned reports, I concur with the views of the Board of Engineers for Rivers and Harbors, and therefore report that, subject to the enactment of legislation as recommended by the board, the improvement by the United States of Sabine River is deemed advisable to the extent of constructing a suitable snag boat and operating it for a period of one year, at an estimated cost of \$30,000, and continuing the work thereafter so long as sufficient revenue is derived from the sale of logs to pay for the operation of the plant. The full amount of the above estimate should be provided in one appropriation.

GALVESTON HARBOR, TEX.

Location and description.—On the Gulf of Mexico, on the east coast of Texas, 345 miles west of the mouth of the Mississippi River and 188 miles northeast of Aransas Pass, and 313 miles northeast from the Rio Grande. The harbor extends from the Gulf through the pass between the jetties on Galveston Island and Bolivar Peninsula to Bolivar Roads, where it connects with the ship channels to Galveston, Texas City, Houston, and Port Bolivar. The harbor lies between Galveston Island, Pelican Island, and Bolivar Peninsula, with an anchorage area of 744 acres with over 30 feet depth.

Condition at the end of fiscal year.—The project was completed in fiscal year 1910 by extension of the jetties gulfward on each side of the pass with crest 5 feet above mean low tide, the north jetty from Bolivar Peninsula, a distance of 25,907 feet, and south jetty from Galveston Island, a distance of 35,900 feet, 7,000 feet apart at outer end. The tidal scour assisted by dredging has formed a channel midway between the jetties 32½ feet deep at mean low tide and 1,450 feet wide between 30-foot contours. Attention is especially invited to the map¹ accompanying this report, which shows the condition of the outer bar channel in June, 1916. The limiting depth of 32½ feet of that channel exists after a period of two years, during which time no dredging whatever was done at this locality. The results obtained, therefore, appear to be of a permanent character. The old channel around outer end of south jetty is gradually filling up and

¹ See Annual Report of the Chief of Engineers.

is no longer used. A total of \$2,901,589.48 has been expended, of which \$2,004,935.66 was for new work, including cost of seagoing dredge *Galveston*, and \$896,653.82 was for maintenance.

Local cooperation.—A pile revetment about 1 mile long had been constructed by the city of Galveston in the vicinity of Fort Point in 1869–70 to prevent erosion and direct the current across the inner bar. The available funds for construction of jetties becoming exhausted the city of Galveston contributed the sum of \$100,000 in May, 1883, to carry on the work of improvement, pending congressional appropriations.

Effect of improvement.—Has afforded a deep-water port on the western side of the Gulf of Mexico, giving an outlet to the products of the States west of the Mississippi River and making Galveston the second port of the United States in value of exports. During the past year a large tonnage of freight from the Pacific coast has been transferred to coastwise vessels and shipped to Atlantic ports in competition with the all-water route via Panama Canal. Freight rates on all commodities had been decreased until the outbreak of the European war, and consequent shortage of vessels forced the rates up to unusual heights.

Proposed operations.—With the funds available on July 1, 1916, amounting to \$27,879.88, together with the appropriation of \$325,000 carried by the river and harbor act approved July 27, 1916, it is proposed to maintain the channel by operating one seagoing dredge at such times as may be necessary, at a probable rate of \$10,000 per month, \$102,879.88, and to repair the jetties at a cost of \$278,000 by contract at the rate of about \$20,000 per month. It is expected that the available funds will be exhausted about January 31, 1918.

With the funds to be furnished under the estimate submitted in the report it is proposed to maintain the channel by operating one seagoing dredge for about five months, at rate of \$10,000 per month, \$50,000.

Commercial statistics.—All the coastwise and foreign commerce for Galveston, Texas City, Port Bolivar, and Houston goes through this channel. The chief articles of export are cotton and cotton products, wheat, flour, copper, lead, and forest products; and of imports fuel oil, coal, sugar, zinc ore, and general merchandise.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	5, 157, 421	\$548, 272, 978
1914.....	5, 593, 725	494, 820, 669
1915.....	6, 231, 575	575, 170, 302

The 1915 increase is accounted for by better cotton values and increase in the movement of wheat and mining products.

Amount expended on all projects from June 23, 1874, to June

30, 1916:

New work	\$10, 426, 932. 23
Maintenance	994, 341. 67

Total	11, 421, 273. 90
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Balance available for fiscal year ending June 30, 1917.....	352, 879. 88
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Amount that can be profitably expended in fiscal year ending

June 30, 1918, for maintenance of improvement.....	50, 000. 00
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GALVESTON CHANNEL, TEX.

Location and description.—This channel extends from Galveston Harbor at a point between Bolivar Peninsula and Fort Point across the former inner bar to and along the wharf front of Galveston, and has a length of about 5 miles and width of 1,400 feet; it is about 5 miles southwest of Port Bolivar and $7\frac{1}{2}$ miles southeast of Texas City.

Existing project.—Adopted by river and harbor act approved June 25, 1910, provides for the excavation of a channel 30 feet deep at mean low tide and 1,200 feet wide from outer end of old inner bar, near Fort Point to Fifty-first Street, and the extension, when the interests of navigation and commerce require it, of a channel 1,000 feet wide to Fifty-seventh Street, at an estimated cost of \$1,769,710. (See H. Doc. No. 328, 61st Cong., 2d sess.)

The river and harbor act approved July 27, 1916, adopted so much of the project presented in House Document No. 1390, Sixty-second Congress, third session, as provides for the construction of the seawall extension, estimated to cost \$1,185,000, and made an appropriation of \$200,000, subject to the following conditions:

That no part of the amount herein appropriated shall be expended and no contract shall be entered into under this appropriation until the county or city of Galveston and other local interests shall have donated the lands to the United States, as set forth in said Document Numbered Thirteen Hundred and ninety, and shall have quieted all claims to the present San Jacinto Reservation, nor until the said county or city of Galveston shall have obtained a right of way and made provision in a manner satisfactory to the Secretary of War for paying the cost of constructing at least three thousand three hundred feet of similar seawall extension in addition to that herein appropriated for: *Provided further*, That the entire work of construction shall be done under the direction of the Secretary of War, and the funds appropriated by Congress and those furnished by the county or city of Galveston shall be expended by him.

The tidal variation is about 1 foot. The latest map is printed in Annual Report for 1914, page 2285.

Condition at end of fiscal year.—The project was completed in fiscal year 1913, with exception of extension of channel westward from Forty-sixth Street and Fifty-seventh Street, the Chicago, Rock Island & Gulf Railway Co. not having developed their property in accordance with the provisions of the project. A channel over 30 feet deep at mean low tide and over 1,200 feet wide has been dredged from Galveston Harbor at Fort Point over the site of old inner bar to Forty-sixth Street, a distance of 4 miles westward, with a pile and brush dike and fence along the north side to retain the spoil excavated from the channel. This spoil bank has formed a strip of land about one-half mile wide and 4 miles long adjacent to the deep-water channel and opposite to the present docks, which is owned by the city of Galveston and is now available for development, and which would, if improved, almost double the capacity of the port. The ruling depth on June 30, 1916, was 28.8 feet, with a depth of over 30 feet through a narrow channel along the wharf front. A total of \$1,247,333.37 has been expended, of which \$710,800.02 was for new work and \$536,533.35 for maintenance.

Local cooperation.—The city of Galveston had built about 1 mile of pile bulkhead on south side of inner bar near Fort Point to protect

the east end of island from erosion and to direct the currents across the inner bar. The Southern Pacific Steamship Co. built a pile dike 3,757 feet long in extension of the Government pile and brush dike on opposite side of the channel and in front of their wharves, and this company and the Galveston Wharf Co. maintain the required depths in slips and for 75 feet in front of face of their wharves by dredging at their own expense.

Effect of improvement.—Has been to make Galveston the second port of the United States in value of exports, providing a convenient outlet for the products of the Middle and Southwestern States.

Proposed operations.—The funds available on July 1, 1916, amounting to \$22,888.86, together with \$100,000 appropriated by the river and harbor act approved July 27, 1916, will be used in the redredging of channel with one or more hydraulic pipe-line dredges as soon as available for the work, at the probable rate of \$10,000 to \$20,000 per month. It is expected that the available funds will be exhausted about June 30, 1917.

With the funds to be furnished under the estimate submitted in the report it is proposed to operate one or more hydraulic pipe-line dredges in maintaining the project depth of 30 feet, at a cost of \$100,000.

It is believed that further extension of the channel westward or any other work than maintenance should not be done until some serious effort is made by the local interests to utilize the undeveloped frontage where the Government has already provided deep water.

Commercial statistics.—The chief articles of export are cotton, cotton products, wheat, flour, copper, lead, and forest products; and of imports, fuel oil, coal, sugar, zinc ore, and general merchandise. The 1915 increase is accounted for by better cotton values and increase in the movement of wheat and mining products.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	4,455,088	\$489,022,813
1914.....	5,019,794	451,985,152
1915.....	5,336,889	510,744,587

This port stands second in the value of foreign exports of all the ports in the United States, according to statistics published by the Bureau of Foreign and Domestic Commerce for the fiscal year ending June 30, 1915.

Amount expended on all projects from June 13, 1902, to June 30, 1916:	
New work	\$1,211,849.39
Maintenance	585,219.10
Total.....	1,797,068.49
Balance available for fiscal year ending June 30, 1917.....	
\$322,888.86	
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	
100,000.00	

CHANNEL FROM GALVESTON HARBOR TO TEXAS CITY, TEX.

Location and description.—Texas City, Tex., is on the mainland of Texas on the west side of Galveston Bay, about $7\frac{1}{2}$ miles northwest of city of Galveston. The channel extends from deep water in Galveston Harbor off Bolivar Peninsula to the wharves, a distance of about 7 miles.

Existing project.—Adopted by river and harbor act approved March 4, 1913, provided for the widening of the channel to 300 feet on the bottom, 30 feet deep at mean low tide, and the construction of a pile dike on the north side 28,200 feet in length, provided "that a gap of 100 feet in width shall be left between the western end of this dike and the Texas City Harbor lines, to permit the passage of small boats." The estimated cost of the project was \$1,400,000, with \$50,000 annually for maintenance. (See H. Doc. No. 1390, 62d Cong., 3d sess.) The tidal variation is about $1\frac{1}{4}$ feet. The latest map is printed in Annual Report for 1914, page 2285.

Condition at the end of the fiscal year.—The project was completed May 12, 1916. The channel has been dredged to a depth of 30 feet at mean low tide and to a width of 300 feet from Bolivar Roads to the wharves at Texas City, a distance of 35,587 feet. The pile dike has been built from the shore along the north side of the channel for a distance of 28,200 feet, and completed June 1, 1915, the spoil, excavated from channel and borrowed elsewhere, deposited over it to protect from action of teredo. The spoil bank has also been protected from erosion by a riprap apron at several places, and further work of placing riprap is in progress. The hurricane of August 16–17, 1915, washed away considerable of the spoil embankment, which is being replaced with Government plant. The hurricane also caused some shoaling of the channel. For original work the sum of \$1,184,023.91 was expended and for maintenance \$267,361.28, a total of \$1,451,385.19.

Local cooperation.—During 1895–96 the Texas City Terminal Co. undertook the development of the port by dredging a channel about 16 feet deep at mean low tide and 100 feet wide from Galveston Harbor to Texas City, at a cost of \$146,000. This channel was taken over by the United States under act of March 3, 1899, and was deepened to 25 feet at mean low tide and 100 feet wide. In 1906 the Texas City Transportation Co. redredged the channel to depth of 25 feet at mean low tide and dredged turning basin and slip, expending a total of \$337,670.17, according to figures furnished by them. The existing project, adopted under act of March 4, 1913, was subject to the condition, which has been complied with—

that the work proposed shall be contingent upon the setting aside by the town of Texas City of a suitable right of way for a railroad or railroads through the said city within its limits, said right of way to be available to any railroad or railroads that may at any time be authorized by the United States to occupy or operate over said dike.

Effect of the improvement.—Established Texas City as a port for ocean vessels handling a large volume of business, new steamship lines entering this service, and competing with the port of Galveston.

Proposed operations.—With the funds available on July 1, 1916, amounting to \$87,181.18, together with \$185,000 appropriated by the

river and harbor act approved July 27, 1916, it is proposed to maintain the project depth of 30 feet, and to maintain covering of pile dike by operating one or more United States hydraulic pipe-line dredges at the rate of \$12,000 per month each. It is expected that the funds available will be exhausted about December 31, 1917.

With the funds to be furnished under the estimate submitted in the report it is proposed to maintain the channel by dredging and to maintain the pile-dike covering by operating one or more United States hydraulic pipe-line dredges, as may be required, at a cost of \$50,000.

Commercial statistics.—The chief articles of export were cotton, metals, and grain; and fuel oil, coal, wire goods, and general merchandise were the largest items of import. The 1915 increase is accounted for by better cotton values.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	416,228	\$52,794,347
1914.....	301,106	32,020,182
1915.....	309,789	41,468,434

Amount expended on all projects from Mar. 4, 1890, to June 30, 1916:

New work.....	\$1,550,846.39
Maintenance	462,444.49
Total.....	2,013,290.88

Balance available for fiscal year ending June 30, 1917.....	272,181.18
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	50,000.00

CHANNEL TO PORT BOLIVAR, TEX.

Location and description.—Port Bolivar is at the end of Bolivar Peninsula, on east coast of Texas, between Gulf of Mexico and Galveston Bay, and is about 4 miles north of city of Galveston. The channel connects Galveston Harbor with a turning basin 1,000 feet square at the wharves.

Existing project.—Was adopted by river and harbor act approved June 25, 1910, and provided for the deepening of the channel from 25 to 30 feet at mean low tide, and widening from 150 to 200 feet, with a turning basin 1,000 feet square and 30 feet deep in front of the wharves, at an estimated cost of \$91,080. (See H. Doc. 328, 61st Cong., 2d sess.) The latest map is printed in Annual Report for 1914, page 2285. The complete project contemplates a channel 200 feet wide and 30 feet deep at mean low tide, with a turning basin 1,000 feet square of the same depth, at an estimated cost of \$91,080. Tidal variation about 1½ feet.

Condition at the end of fiscal year.—The channel had been dredged from deep water in Bolivar Roads to the wharves, a distance of 4,240 feet. 30 feet deep at mean low tide and 200 feet wide, ending at a turning basin 1,000 feet square, completed in fiscal year 1912 at a total cost of \$246,447.72, of which \$85,213.85 was for original

work and \$161,233.87 for maintenance. The ruling depth June 30, 1916, is 24.5 feet.

Effect of improvement.—Provided a deep-water port on Bolivar Peninsula, effecting considerable saving in distance of haul for lumber and logs from east Texas timber belt and an outlet for iron ore from northeast Texas.

Proposed operations.—It is estimated that the amount that should be applied to work of maintenance to June 30, 1918, is about \$84,600, thus requiring an additional appropriation of \$30,000, and an estimate for this sum is submitted.

Commercial statistics.—The chief articles of export are forest products and cotton, and wire goods and miscellaneous articles were imported. The hurricane of August 16–17, 1915, seriously damaged the railroad connection with the port, which accounts for the decrease in tonnage and valuation.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	256,105	\$6,455,818
1914.....	267,640	10,752,535
1915.....	182,450	7,559,765

Amount expended on all projects from Mar. 2, 1907, to June 30, 1916:

New work.....	\$133,924.60
Maintenance.....	207,334.62
Total.....	341,259.22

Balance available for fiscal year ending June 30, 1917..... 54,661.70

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 30,000.00

PORT ARANSAS, TEX.

Location and description.—The locality improved under the title of Port Aransas is on the south coast of Texas, 188 miles southwest of Galveston and 125 miles north of the Rio Grande.

Existing project.—This project, which was adopted by the river and harbor act of March 4, 1913, in accordance with report printed in House Document No. 1125, Sixty-second Congress, third session, provides for repairs to both jetties; extension of the south jetty 2,250 feet and of north jetty 1,950 feet; extension of the stone dike on St. Joseph Island, connecting with the north jetty, 9,100 feet; dredging to a depth of 25 feet at mean low tide and a width of 600 feet between the jetties, and to the same depth in the Harbor Island Basin, forming a roadstead 1,200 feet wide and 3,000 feet long between Harbor and St. Joseph Islands, with an extension of the same depth 400 feet wide for about 5,420 feet leading from the north end of the roadstead, and the dredging of an approach channel 12 feet deep at mean low tide and 100 feet wide, with basin at end leading from Harbor Island Basin to the town of Port Aransas, all at an estimated cost of \$2,325,000, and \$25,000 annually for maintenance. The tidal variation is 1.1 feet. The latest map is printed in Annual Report for 1913, page 2273.

Condition at the end of fiscal year.—Two jetties have been built, the north jetty, 9,241 feet long, extending from south end of St. Joseph Island, and the south jetty, 6,400 feet long, extending from north end of Mustang Island. A stone dike connecting with the north jetty has been built 20,991 feet long on St. Joseph Island. The channel between the jetties has been improved to a depth of 23½ feet at mean low tide and 100 to 400 feet wide for a distance of about 10,000 feet, connecting with Harbor Island Basin or roadstead. This roadstead has been dredged to a depth of 20 feet at mean low tide and a width of 1,200 feet for a distance of 3,000 feet, and an extension from the north end along Harbor Island 150 to 400 feet wide for a distance of 2,000 feet. An area 600 feet wide and 1,650 feet long near the lower end of the Harbor Basin and adjacent to the docks has been deepened to 25 feet at mean low tide. Also an approach channel 12 feet deep at mean low tide and 100 feet wide, with 200-foot basin, has been dredged from the Harbor Basin to town of Port Aransas, on Mustang Island. About 40 per cent of the existing project has been completed. The ruling depth of channel between the jetties was 23.2 feet on June 30, 1916, with a navigable width at narrowest point of about 100 feet. The deep-water harbor had an average depth of 25 feet over that portion which had been previously deepened to 25 feet, and 18 feet in the section dredged to 20 feet, all depths referred to mean low tide. The total amount expended under existing project was \$2,524,018.89, of which \$2,051,539.74 was for new work and \$472,479.15 was for maintenance.

Local cooperation.—At a cost of about \$10,000 the citizens of Corpus Christi and Rockport built a short section of cribwork from St. Joseph Island in 1868, which was soon destroyed. The Aransas Pass Harbor Co. expended the sum of \$401,554.18 on reaction jetty and other improvements for the harbor under authority of river and harbor act of May 12, 1890, and relinquished their rights on May 27, 1899. A small channel 8 feet deep and 100 feet wide was dredged in 1874 between Aransas Bay and Corpus Christi Bay. The conditions imposed by river and harbor act of February 27, 1911, providing that all easements and titles for any land needed in the construction of the dike, and that the interests of the general public will be duly protected and no monopoly of the terminals shall be possible, have been complied with, as have also the provisions of the river and harbor act of March 4, 1913, requiring the town of Port Aransas to construct a suitable bulkhead to retain the spoil excavated from the approach channel. The Aransas Pass Channel & Dock Co. have dredged a channel from the docks on Harbor Island to the town of Aransas Pass, a distance of 6 miles; this channel is 8½ feet deep and 75 feet wide, and was dredged at a cost of about \$100,000.

Effect of the improvement.—This port has been placed on a parity with Galveston as regards freight rates, and now has regular sailings of two or three vessels per month.

Proposed operations.—With the balance of \$141,819.11 available on July 1, 1916, it is proposed to carry on the work of repairing the north and south jetties and building of wharf under existing contracts, \$105,269.29, and to improve and maintain the channel between the jetties by the operation of one or more Government dredges for about six months, \$36,549.82, which will exhaust the available funds about December 31, 1916.

With the funds appropriated by the act of July 27, 1916, it is proposed to continue work of improvement and maintenance of channel between jetties by use of Government dredges, \$70,000, and to do such redredging of deep-water harbor, \$25,000, and of channel to town of Port Aransas, \$5,000, as may be necessary, with Government plant or by contract.

With the funds estimated in this report it is proposed to do the following work:

Maintaining channel between jetties with Government dredges.....	\$70, 000
Maintaining deep-water harbor in front of docks with hydraulic pipe-line dredge	25, 000
Maintaining channel to Port Aransas with hydraulic pipe-line dredge..	5, 000
Total.....	100, 000

Commercial statistics.—Cotton, forest products, and fuel oil are the principal items of commerce. In addition to that shown most of the commerce shown under "Channel from Aransas Pass to Corpus Christi" moved over this waterway.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	211, 330	\$5, 201, 032
1914.....	192, 701	2, 061, 253
1915.....	120, 389	3, 053, 072

Amount expended on all projects from Mar. 3, 1879, to June 30, 1916:

New work.....	\$3, 143, 720. 49
Maintenance.....	472, 479. 15
Total	3, 616, 199. 64

Balance available for fiscal year ending June 30, 1917.....	241, 819. 11
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	100, 000. 00

HARBOR AT SABINE PASS AND PORT ARTHUR CANAL, TEX.

Location and description.—The harbor at Sabine Pass is on the Gulf of Mexico between Texas and Louisiana. It is approximately 80 miles from Galveston and 435 miles from New Orleans. The Port Arthur Canal extends from near the upper end of Sabine Pass to the Port Arthur docks at the mouth of Taylors Bayou, a distance of 7 miles. Near its upper end the Sabine-Neches Canal joins it. Sabine Pass is the natural outlet from Sabine Lake to the Gulf of Mexico and is about 7 miles long, the width varying from 1,700 to about 5,000 feet. The entrance is protected by two jetties extending into the Gulf about 4 miles.

Existing project.—The river and harbor act approved July 25, 1912, authorized changes in the project as follows: (a) The repair and building up of the jetties as far as the mattress foundation is laid, so as to provide a reasonably permanent channel of 25 feet

navigable depth; (b) dredging Port Arthur Canal 26 feet deep and 150 feet wide and dredging a new turning basin 26 feet deep, 600 feet wide, and 1,700 feet long; all at an estimated cost of \$2,000,000, with \$290,000 for maintenance the first year, including \$100,000 for a new dredge, and \$190,000 annually for maintenance thereafter. (H. Doc. No. 773, 61st Cong., 2d sess.) The present complete plan of improvement therefor provides for: (a) Obtaining and maintaining a channel of 25 feet navigable depth at mean low Gulf level and suitable width throughout Sabine Pass and entrance by dredging and by the construction and maintenance of two rubble mound jetties, of which the eastern one is to be approximately 26,300 feet long and the western one approximately 22,000 feet long; (b) dredging and maintaining the Port Arthur Canal 26 feet deep and 150 feet wide and two turning basins, each 26 feet deep, one 600 feet wide and 1,700 feet long and the other 420 feet wide and 1,800 feet long. The mean tidal variation at the entrance is about $1\frac{1}{2}$ feet and at Port Arthur about 1 foot. The effect of the wind is often greater than that of the tide. For map, see Annual Report, 1915, page 2672.

Condition at the end of fiscal year.—Channels of 12 to 15 feet at mean low Gulf level had been dredged across the bar prior to 1882, but could not be maintained. Under the combined jetty and dredging projects, two jetties have been constructed across the bar and completed to full height 4 feet above mean low Gulf level, practically as follows: East jetty, 22,250 feet; west jetty, 15,800 feet; the remaining portions being completed to different heights. The work of raising and repairing the jetties is approximately 45 per cent completed. Dredging was carried on intermittently by contract from 1893 to 1903, and, since its completion in 1901, has been carried on almost continuously by the U. S. dredge *Sabine* in the jetty channel and at the mouth of the Port Arthur Ship Canal. The yardage removed by the latter is 6,112,004. The U. S. dredge *Orange* has also removed 335,238 cubic yards from the jetty channel. The full project depth of 25 feet at mean low Gulf level has been secured and maintained, both in the Pass and jetty channel. The portion of the project covering the Port Arthur Canal and the new turning basin was completed in the fiscal year 1915 for \$171,490.75 less than the estimate. The total expenditure under the existing project up to the end of the fiscal year was \$1,253,720.84, of which \$810,741.52 was for new work and \$442,979.32 for maintenance. The work remaining to be done is building up the unfinished outer portions of the jetties, minor repairs to the completed portion of the east jetty, and continuing the maintenance dredging. The controlling depth at the end of the fiscal year was 27.5 feet at mean low Gulf level in Sabine Pass and the jetty channel and 27 feet in the Port Arthur Canal.

Local cooperation.—In 1902, \$8,800 worth of dredging in the jetty channel by the U. S. dredge *Sabine* was paid for by the Kansas City Southern Railway Co. The Port Arthur Canal, with turning and lumber basin, were originally constructed by private interests at a cost placed at \$661,138, and transferred to the United States without cost, being accepted by the Secretary of War December 13, 1906. The following table gives a summary of the condition of the canal at the time of its acceptance by the United States:

	Length.	Average top width.	Width between 20-foot contours.	Maxi- mum depth.	Mini- mum depth.
	<i>Fect.</i>	<i>Fect.</i>	<i>Fect.</i>	<i>Fect.</i>	<i>Fect.</i>
Canal.....	37,600	200	80	25.1	22.0
Turning basin.....	1,800	625	530	27.1	23.7
Lumber basin.....	1,200	160	100	26.2	23.1

Under the proviso of the present project requiring the right of way for the new turning basin to be furnished without cost to the United States, deeds and abstracts of title covering this right of way have been furnished by the local interests.

Effect of improvements.—The improvements at this harbor have enabled deep-draft ocean-going vessels to enter and have resulted in the development of a very large commerce. The reduction in freight rates can not be accurately determined.

Proposed operations.—It is proposed to expend the funds now available as follows:

New work:

- (a) For building up the east jetty to full height to about station 245 (24,500 feet from the shore end)..... \$260,307. 92

It is expected that contract will be let about November, 1916, and the work completed about Aug. 1, 1917.

Maintenance:

- (b) Construction of new dredge to replace the U. S. dredge *Sabine*..... \$225, 000. 00

It is expected that contract will be entered into for this dredge during the present year and that the amount of the contract will practically cover the available funds.

- (c) Operating the U. S. dredge *Sabine* 1 year, Aug. 15, 1916, to Aug. 15, 1917..... 40, 590. 80

- (d) Operating the U. S. dredge *Orange* 10 to 11 months during the period July 1, 1916, to Oct. 1, 1917..... 68, 620. 38

- (e) Repairing completed portion of east jetty.... 25, 000. 00

359, 211. 18

This will be done as a part of the contract for building up the jetty and the work will be completed by Aug. 1, 1917.

Total for improvement and maintenance..... 619, 519. 10

It is proposed to expend the funds for which estimates are now submitted in continuing and maintaining the work according to the approved project, the amounts to be expended substantially as follows:

New work:

- (a) For building up the east jetty to full height to about station 259 (25,900 feet from the shore end)..... \$300, 000. 00

Maintenance:

- (b) For operating U. S. dredge *Sabine* 10½ months, Aug. 15, 1917, to June 30, 1918..... \$35, 000. 00

- (c) For operating U. S. dredge *Orange* about 5 months during the period Oct. 1, 1917, to June 30, 1918..... 30, 000. 00

- (d) For repairs to completed portions of jetties... 25, 000. 00

90, 000. 00

Total for improvement and maintenance..... 390, 000. 00

The operation of the dredges *Sabine* and *Orange* for the periods indicated is necessary to fully maintain project dimensions. The Port Arthur Ship Canal was maintained during the fiscal years 1914 and 1915 from the permanent indefinite appropriation for operating and care of canals and other works of navigation, and including the amounts so expended the estimate for maintenance dredging now submitted is not greater than the average amount expended for that purpose during the preceding three years.

Commercial statistics.—In general this commerce consists of crude petroleum and its refined products, lumber and its products, sulphur, cotton and cottonseed meal, shell, and a small amount of general merchandise.

Comparative statement.

Calendar year.	Sabine Pass.		Port Arthur Canal.	
	Short tons.	Value.	Short tons.	Value.
1913.....	4, 758, 408	\$86, 437, 688	3, 171, 758	\$62, 134, 154
1914.....	5, 569, 454	81, 195, 898	4, 090, 928	60, 814, 058
1915.....	6, 001, 885	100, 524, 639	4, 533, 864	77, 765, 725

The increased tonnage and value in 1915 were due mainly to largely increased shipments of oils.

Amount expended on all projects from Mar. 3, 1875, to June 30, 1916:

New work.....	\$4. 650, 155. 70
Maintenance	1. 151, 413. 33

Total.....	5, 801, 569. 03
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Balance available for fiscal year ending June 30, 1917.....	619, 519, 10
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Amount (estimated) required to be appropriated for completion of existing project.....	768, 800. 00
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Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement.....	300, 000. 00
For maintenance of improvement.....	90,000. 00

Total	390, 000. 00
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HOUSTON SHIP CHANNEL, TEX.

Location and description.—The channel improved under this title connects Galveston Harbor, at a point opposite Port Bolivar, with the city of Houston, Tex., extending 50 miles in a northwesterly direction across Galveston Bay through the San Jacinto River and Buffalo Bayou to a turning basin 600 feet in diameter, at the head of Long Reach, with a light-draft channel 7 miles long from the turning basin to Main Street, Houston.

Existing project.—This project was adopted by the river and harbor act approved March 3, 1899 (as amended by an act approved Feb. 20, 1900), and provided for securing a channel 25 feet deep at mean low tide, 150 feet wide in bay, and 100 feet wide thence to

Houston, with two turning basins at the upper end, at an estimated cost of \$4,000,000 and \$100,000 annually for maintenance. (See H. Doc. No. 99, 55th Cong., 2d sess., which contains the latest map published.)

Was modified by river and harbor act approved March 3, 1905, so as to terminate the 25-foot channel with a turning basin 600 feet wide at or near the head of Long Reach, 4 miles by land and 7 miles by water below Houston, and construction of a dike 26,000 feet long to protect channel in upper bay, together with excavation of cut-offs at sharp bends in the bayou sections, at an estimated cost of \$3,550,000 in addition to the \$1,300,000 previously appropriated. (See R. and H. Com. Doc. No. 35, 61st Cong., 2d sess.)

The river and harbor act approved March 2, 1907, appropriated \$50,000 for the restoration of channel between Main Street, Houston, and head of Long Reach to depth of 8 feet and width of 40 feet.

The river and harbor act approved June 25, 1910, authorized an expenditure of \$2,500,000, provided that one-half of this amount, or one-half the cost of the work, should be furnished by local interests, and the river and harbor act approved March 4, 1913, authorized the purchase or construction of two suitable dredging plants for maintenance of the improvement at a cost of \$400,000, one-half of the amount to be furnished by local interests.

The existing project, therefore, contemplates a channel 25 feet deep at mean low tide, 150 feet wide across Galveston Bay, and 100 feet wide from Morgan Point to head of Long Reach, where it terminates in a turning basin 600 feet in diameter, with an extension of channel 8 feet deep and 40 feet wide, thence to foot of Main Street in Houston, Tex.; the project also includes the construction of a dike 26,000 feet long to protect the channel in the upper bay. Tidal variation: Lower Galveston Bay, 1.3 feet; upper bay, 0.5 foot; and San Jacinto River and Buffalo Bayou, less than 0.5 foot. Freshets sometimes cause rises of over 12 feet in Buffalo Bayou.

Condition at the end of fiscal year.—The project has been completed, except that only 11,400 feet of the authorized 26,000 feet of the experimental dike has been constructed in upper bay. A channel 25 feet deep at mean low tide has been dredged from deep water in Bolivar Roads to head of Long Reach, ending in a turning basin over 600 feet in diameter, the channel over 150 feet wide in bay and 100 feet wide in bayou sections. Two pipe-line dredges had been built and are in use maintaining the channel. A section of creosoted sheet-pile dike 11,400 feet long had been constructed in the upper bay section. The ruling depth on June 12, 1916, in Galveston Bay was 24½ feet, and thence to Clinton, a distance of 21 miles, 25 feet, shoaling to 22 feet at lower end of Long Reach and over 25 feet thence to turning basin. The sum of \$5,377,450.89 has been expended under existing project, of which \$4,332,646.65 was for original work and \$1,044,804.24 for maintenance.

Local cooperation.—In 1870–1876 a canal was constructed through Morgan Point and extending a distance of 5 miles into upper Galveston Bay about 14 feet deep and 150 feet wide, which was purchased from the Buffalo Bayou Ship Channel Co. in 1892 by the United States at a cost of \$92,316.85. In compliance with the provisions of river and harbor act approved June 25, 1910, the citizens of Harris County, Tex., contributed the sum of \$1,206,297.83, being one-

half the cost of constructing the Houston Ship Channel to depth of 25 feet, and in accordance with the provisions of river and harbor act approved March 4, 1913, they contributed the sum of \$200,000 as one-half the cost of building two pipe-line dredges for maintenance of the channel. The city of Houston also redredged the upper section of bayou between turning basin and foot of Main Street, Houston, to depth of 8 feet and width of 40 feet in 1913-14 at a cost of about \$45,000 and contributed the sum of \$1,625.78 as one-half the cost of removing with Government plant the snags, logs, etc., from this section. With the proceeds of a \$3,000,000 bond issue the city of Houston has constructed a municipal dock 625 feet long, with warehouse 100 by 416 feet, a cotton dock about 850 feet long, and 5.75 acres of cotton-storage sheds, and has excavated a total of 1,574,930 cubic yards of earth in enlarging turning basin and providing berths for vessels alongside of 1,500 feet of docks now under construction, expending the sum of \$789,681 to end of fiscal year.

Effect of the improvement.—Water rates are now applied to Houston, the port being on a parity with Galveston and Texas City, and 50 miles farther inland. A regular line of steamers between Houston and New York with 10-day sailings has been established, with irregular tramp sailings. Several industrial plants, such as cotton compresses and warehouses, fertilizer plants, cement factory, oil-mixing plant, and boat yards, have been constructed along the channel.

Proposed operations.—With the balance of \$29,195.18 available on July 1, 1916, together with the \$250,000 appropriated by the river and harbor act approved July 27, 1916, it is proposed to maintain the channel to project depth of 25 feet by operating two hydraulic pipe-line dredges at rate of \$10,000 per month each for the entire year, and to operate one snag boat for about three months at rate of \$1,500 per month. It is expected that the available funds will be exhausted about August 31, 1917.

With the funds to be furnished under the estimate submitted in the report it is proposed to operate two hydraulic pipe-line dredges for the entire year in maintaining the channel at an estimated cost of \$250,000.

Commercial statistics.—The chief articles of export were cotton, oil, and rice, and ammunition, groceries, iron and steel products, forest products, phosphate rock, and general merchandise were the chief items of import. The 1915 increase is accounted for by better cotton values and for the reason that it was the first full business year for the channel since completion. The first unit of the municipal wharves was completed in August, 1915, and a regular line of steamships established between Houston and New York the latter part of August, 1915, effecting a saving in freight rates of 6 to 17 cents per hundred pounds over the combined rail and water rates through the port of Galveston, according to figures furnished by the Houston Chamber of Commerce.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	1, 860, 452	\$38, 738, 464
1914.....	1, 070, 700	24, 382, 700
1915.....	1, 656, 347	31, 406, 916

United States funds.

Amount expended on all projects from June 10, 1872, to June 30, 1916:

New work-----	\$4, 136, 814. 62
Maintenance-----	844, 804. 24
Total -----	4, 981, 618. 86
Balance available for fiscal year ending June 30, 1917-----	279, 195. 18
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	250, 000. 00

WEST GALVESTON BAY CHANNEL; TURTLE BAYOU; TRINITY RIVER, ANAHUAC CHANNEL; OYSTER CREEK; CEDAR, CHOCOLATE, AND BASTROP BAYOUS, TEX., INCLUDING MOUTHS OF ADJACENT STREAMS.

The above title embraces all work of improvement on the small streams emptying into Galveston Bay and connecting waters lying between east end of East Galveston Bay and the Brazos River, affording them light-draft navigation and connection with the inland waterway.

(A) CHANNEL ACROSS HANNA REEF—EAST BAY BAYOU.

Proposed operations.—It is proposed to use the balance of \$475.85 available on July 1, 1916, and such amount of unallotted funds as may be required to maintain a navigable channel through the reef by operating one United States snag boat or hydraulic pipe-line dredge for about six days at a cost of \$1,000. As redredging may not be required for several months, it is not known when the funds will be exhausted.

(B) DOUBLE BAYOU.

Location and description.—This bayou enters upper Galveston Bay on the east side about 30 miles north of Galveston and about 8¼ miles south of Anahuac. The bayou is divided into east and west branches about one-half mile from the mouth, the east branch being navigable for 12 miles and west branch for 8 miles above the mouth.

Existing project.—The river and harbor act approved March 3, 1899, contained an item providing for the improvement of "Brazos River, between Velasco and Richmond, West Galveston Bay Channel, Double Bayou, and mouths of adjacent streams." Since at this time there was before Congress a report printed in House Document No. 387, Fifty-fifth Congress, second session, containing an estimate of \$20,000 for a channel 6 feet deep and 100 feet wide through the bar at the mouth of Double Bayou, the dimensions mentioned are assumed as those of the adopted project. The latest map is published in House Document No. 387, Fifty-fifth Congress, second session. Tidal variation, about 1 foot.

Condition at end of fiscal year.—The project is about 85 per cent completed, a channel 5 to 7 feet deep at mean low tide and 60 to 85 feet wide having been dredged. Ruling depth on June 30, 1916, was 3.2 feet, the hurricane of August 16–17, 1915, having caused considerable shoaling. Total expenditures to June 30, 1916, \$6,953.20 for original work and \$22,196.85 for maintenance, a total of \$29,150.05.

Local cooperation.—There being no funds available for maintenance of this channel, private parties contributed the sum of \$2,711.40 to pay the operating cost of redredging this channel in 1905–6.

Effect of the improvement.—Has been to afford an outlet for farm products and means of securing needed supplies to quite a large farming community, the nearest railway being about 30 miles distant.

Proposed operations.—It is proposed to use the balance of \$127.88 available on July 1, 1916, together with such amount of the unallotted funds as may be required to remove shoals in channel by operating one hydraulic pipe-line dredge for a period of seven weeks at a cost of about \$9,000, which will probably exhaust the available funds by June 30, 1917.

With the funds to be furnished under the estimate submitted in the report it is proposed to redredge the entire channel for its full length and project depth, if necessary, by operating one hydraulic pipe-line dredge for one month at cost of about \$5,000. This estimate for 1918 is larger than the average expenditure for the last three years, as it has been found that previous expenditures have not been sufficient to properly maintain the channel, storms considerably affecting this locality.

Commercial statistics.—The increased valuation is due to a greater production of rice and produce and greater importation of groceries, the chief articles handled through this waterway.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	7,835	\$195,462
1914.....	5,574	279,523
1915.....	5,853	316,792

Amount expended on all projects from Mar. 3, 1899, to June 30, 1916:	
New work.....	\$6,953. 20
Maintenance.....	22,196. 85
Total	29,150. 05
July 1, 1916, balance unexpended.....	127. 88
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	
	5,000. 00

(C) ANAHUAC CHANNEL.

Location and description.—The town of Anahuac is on north-east side of upper Galveston or Trinity Bay, opposite mouth of the Trinity River, 38 miles north of Galveston and 25 miles northeast of Seabrook. The channel is about 3 miles long and extends from 6 feet depth at mean low tide in the bay to the wharf and slip at Anahuac, connecting with channel to Trinity River through Browns Pass.

Existing project.—The river and harbor act approved March 3, 1905, contained an item for “Improving West Galveston Bay Channel, Double Bayou, and mouths of adjacent streams, including Trinity River, Anahuac Channel, and Cedar Bayou,” but at the time of the appropriation no recommendation of definite channel dimen-

sions had been made to Congress. A channel 6 feet deep at mean low tide and 80 feet wide was dredged from Galveston Bay to the wharves at Anahuac, a distance of 16,000 feet. The latest map is published in House Document No. 440, Fifty-sixth Congress, first session. Tidal variation about one-half foot.

Condition at the end of fiscal year.—The project was completed in 1911. The ruling depth on June 30, 1916, was 4.3 feet at mean low tide. A total of \$27,035.81 has been expended, of which \$5,975.10 was for new work and \$21,060.71 was for maintenance.

Local cooperation.—A slip at Anahuac Wharf was dredged with United States plant, the cost of operation being paid by local interests. In 1912, there being no Government plant available, the dipper dredge *Thos. H. Ball* was borrowed from the city of Houston and the channel redredged, the United States paying only the cost of operation.

Effect of the improvement.—There is no railroad communication with this locality, and all produce and supplies pass through this channel, which is also used by the United States mail boats. The channel now connects with channel to mouth of Trinity River and is used as a link of that waterway.

Proposed operations.—The balance of \$4.54 available on July 1, 1916, together with such amount of the unallotted funds as may be required, will be used in maintaining channel and removing snags with Government pipe-line dredge, \$2,200, and snag boat, \$300. It is expected that the available funds will be exhausted about June 30, 1917.

It is proposed to use the funds to be furnished under the estimate submitted in the report in maintenance of channel by dredging and snagging with Government plant at a cost of about \$3,100.

Commercial statistics.—Rice, lumber, and general merchandise are the principal items moved through this channel. The channel is used by the United States mail boats, and, as there is no railroad communication with the adjacent country, all produce and supplies pass through this channel. The statistics for 1915 shown in statement below is the combined tonnage and valuation of "Mouth of Trinity River" and "Turtle Bayou."

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	1,099	\$24,606
1914.....	10,327	217,878
1915.....	21,128	510,082

Amount expended on all projects from Mar. 3, 1905, to June 30, 1916:

New work.....	\$5,975.10
Maintenance.....	21,060.71
Total	27,035.81

July 1, 1916, balance available..... 4.54

Amount that can be profitably expended in fiscal year ending June

30, 1918, for maintenance of improvement..... 3,100.00

(D) MOUTH OF TRINITY RIVER.

Proposed operations.—There being no available balance on July 1, 1916, it is proposed to use about \$3,500 of the funds appropriated by the act of July 27, 1916, in maintenance of channel by dredging and snagging with United States hydraulic pipe-line dredge or snag boat at such time as plant is available for the work. It is expected that the available funds will be exhausted about June 30, 1917.

It is thought that no dredging will be required during fiscal year 1918, and therefore no estimate for funds is submitted.

(E) TURTLE BAYOU.

Location and description.—Turtle Bayou is about $17\frac{1}{2}$ miles long and flows south into Turtle Bay, a small bay at north end of upper Galveston Bay, $3\frac{1}{2}$ miles from Anahuac and $41\frac{1}{2}$ miles from Galveston, Tex. The improved section is at the mouth.

Existing project.—The river and harbor act approved June 25, 1910, contained an item providing for the improvement of "West Galveston Bay Channel, Turtle Bayou, * * * including mouths of adjacent streams." Since at this time there was before Congress a report, printed in House Document No. 440, Fifty-sixth Congress, first session, containing an estimate of \$10,000 for a channel 4 feet deep and 50 feet wide from the mouth of Turtle Bayou across Turtle Bay to the foot of Browns Pass, the dimensions mentioned are assumed as those of the adopted project. The latest map is published in House Document No. 440, Fifty-sixth Congress, first session. Tidal variation, about one-half foot.

Condition at the end of fiscal year.—A channel 5 feet deep at mean low tide and 50 feet wide $3\frac{1}{2}$ miles long was completed in 1911. The ruling depth on June 30, 1916, was 5.7 feet. The sum of \$8,899.97 was expended for original work and \$11,052.99 for maintenance, a total of \$19,952.96.

Local cooperation.—A dam with tidal lock was built across the lower end of Turtle Bay to retain the fresh water in bay and bayou for irrigation purposes. This was built in 1911–12 by the Lone Star Canal Co. under authority of the Secretary of War dated June 25, 1910, but was destroyed by the hurricane of August 16–17, 1915.

Effect of improvement.—Opened line of communication to section not served by railway and which has been developed in rice culture.

Proposed operations.—This channel was recently redredged, and it is possible that work will not be required during the fiscal year 1917. The balance of \$147.04 available on July 1, 1916, will be used for surveys, contingencies, etc., and \$800 of the funds appropriated by the act of July 27, 1916, for snagging or dredging if required, which will probably exhaust the funds by June 30, 1917.

With the funds to be furnished under the estimate submitted it is proposed to maintain the channel during the fiscal year 1918 by operating one hydraulic pipe-line dredge for about three weeks at a cost of \$4,000. This estimate is larger than the average expenditure for the last three years as the intended omission of dredging in 1917 will probably increase the work to be done in 1918.

Commercial statistics.—The principal items carried on this stream are lumber, rice, and general merchandise.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	6,088	\$113,840
1914.....	11,340	238,522
1915.....	15,791	338,819

Financial summary.

Amount expended on all projects from June 25, 1910 to June 30, 1916:	
New work.....	\$8,899.97
Maintenance.....	11,052.99
Total.....	19,952.96
July 1, 1916, balance unexpended.....	147.04
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	4,000.00

(F) CEDAR BAYOU.

Location and description.—This bayou is about 17 miles long, flowing south and emptying into northwest corner of upper Galveston Bay, about $1\frac{1}{2}$ miles below mouth of San Jacinto River, and is about $28\frac{1}{2}$ miles north of Galveston, Tex. The improved section is about 2 miles long, extending from mouth of bayou to 5 feet depth at mean low tide in Galveston Bay.

Existing projects.—The river and harbor act approved March 3, 1905, added this improvement to others covered by the item for "Improving West Galveston Bay Channel, Double Bayou, and mouths of adjacent streams." In the absence of specific adoption of a definite project, the dimensions of the previous project, which provided for a channel 5 feet deep at mean low tide and 100 feet wide through the bar at the mouth of the bayou, have been assumed as those of the existing project; the project also includes the jetties at the mouth of the bayou provided for under the previous project. No maps have been published for this project. Tidal variation, about one-half foot.

Condition at the end of fiscal year.—The project was completed in 1905. A channel 5 to 8 feet deep at mean low tide about 100 feet wide had been dredged from the mouth of bayou to 5 feet depth in Galveston Bay and across Cloppers Bar to mouth of San Jacinto River. Two brush and stone jetties, the north jetty 1,413 feet long and south jetty 2,888 feet long, had been built from shore along each side of the channel, extending about $2\frac{1}{2}$ feet above mean low tide. The sum of \$39,087.15 was expended for original work and \$19,786.78 for maintenance, a total of \$58,873.93. The ruling depth on June 30, 1916, was 4.5 feet at mean low tide, the hurricane of August 16–17, 1915, having caused considerable shoaling.

Effect of improvement.—Provides means of communication with well-settled farming section without railway connection nearer than 12 miles. Boat-building yard and marine ways for repair of barges, tugs, etc., established at town of Cedar Bayou.

Proposed operations.—There is no balance available for this project on July 1, 1916, and it is proposed to apply about \$300 of the

unallotted balance and \$3,700 of funds appropriated by the act of July 27, 1916, in redredging channel when necessary, and the plant is available by operating one United States hydraulic pipe-line dredge for three weeks, which will probably exhaust available funds by December 31, 1916.

With the funds to be furnished under the estimate submitted in the report, it is proposed to maintain the channel by operating one United States hydraulic pipe-line dredge for about one month at cost of \$5,000. The rate of shoaling is not uniform, depending on freshets and storms, and the amount of redredging varies each year.

Commercial statistics.—Rice, cotton, lumber, groceries, and general produce are the principal items carried on this waterway. The 1914 statistics were unobtainable.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	36,930	\$1,075,095
1914.....		
1915.....	96,310	1,339,400

Amount expended on all projects from Sept. 19, 1890, to June 30,

1916:

New work.....	\$39,087.15
Maintenance.....	19,786.78

Total.....	58,873.93
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Amount that can be profitably expended in fiscal year ending June

30, 1918, for maintenance of improvement.....	5,000.00
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(G) CLEAR CREEK.

Location and description.—Clear Creek has its source about 13 miles south of Houston, Tex., and flows southeast for a distance of 25 miles, emptying into the west side of upper Galveston Bay at a point 24 miles northwest of Galveston, Tex. The section under improvement extends from the mouth to Friendswood, a distance of 20 miles.

Existing project.—This locality has been improved as an adjacent stream under the item of the river and harbor act approved June 13, 1902, which made appropriation for "Improvement of the Brazos River, between Velasco and Richmond, Tex., and mouths of adjacent streams." There being before Congress at the time of the appropriation a recommendation (printed in H. Doc. No. 449, 56th Cong., 1st sess.) for a channel 4 feet deep and 50 feet wide across the bar at the mouth and through Clear Lake to deep water in Clear Creek, at an estimated cost of \$10,000, the dimensions mentioned are assumed as those of the existing project. The latest map is published in House Document No. 449, Fifty-sixth Congress, first session. Tidal variation, one-half foot.

Condition at the end of fiscal year.—The project was completed in 1908. A channel with least depth of 6½ feet at mean low tide and 70 feet wide extends from Galveston Bay to deep water in lower section of the creek, and a channel 6 feet deep and 60 feet wide extends across Clear Lake to deep water in upper section of the creek. Snags,

overhanging trees, etc., have been removed from the creek as far as Friendswood, 20 miles above the mouth. Ruling depth on June 30, 1916, 5 feet in entrance channel and 3 feet across lake at mean low tide. The hurricane of August 16-17, 1915, caused considerable shoaling in this channel. A total of \$36,480.16 has been expended, of which \$14,290.95 was for new work and \$22,189.21 for maintenance.

Local cooperation.—Prior to 1899 private parties reported having dredged the channel across bar at mouth of creek at cost of about \$2,500, and in 1907-8 a channel 6 feet deep at mean low tide and about 80 feet wide, extending from 6-foot depth in Galveston Bay to the mouth of creek, a distance of about 4,700 feet, was reported completed at cost of about \$2,500, the work being done by private parties.

Effect of improvement has been to afford navigable waterway connection for towns of Seabrook, Webster, League City, and Friendswood with Houston and Galveston, and especially a means of distributing shell at these places for the county highways and for railway ballast.

Proposed operations.—As there is no balance available for this project on July 1, 1916, it is proposed to use about \$6,000 of the funds appropriated by the act of July 27, 1916, in operating one hydraulic pipe-line dredge for about five weeks.

With the funds to be furnished under the estimate submitted in the report it is proposed to redredge the full length of channel and restore to project depth by operating one United States hydraulic pipe-line dredge for six weeks at a cost of \$7,500.

Commercial statistics.—Mud shell and general merchandise are the principal items moved over this waterway.

Comparative statement.

Calendar year.	Short tons.	Value.
1914.....	23,997	\$13,790
1915.....	8,570	26,898

Amount expended on all projects from June 13, 1902. to June 30.

1916:

New work.....	\$14,290.95
Maintenance.....	22,189.21
Total.....	<u>36,480.16</u>

Amount that can be profitably expended in fiscal year ending June

30, 1918, for maintenance of improvement.....	7,500.00
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(H) DICKINSON BAYOU.

Proposed operations.—There was no balance available for this project on July 1, 1916. It is proposed to use about \$8,500 of the funds appropriated by the river and harbor act approved July 27, 1916, in redredging channel with one United States hydraulic pipe-line dredge working for about six weeks, the channel having shoaled considerably.

As it will probably not be necessary to do any dredging in fiscal year 1918, no estimate for funds is submitted.

(1) CHOCOLATE BAYOU.

Location and description.—This bayou has its source about 25 miles southwest of Houston and flows southeast a distance of about 50 miles, emptying into Chocolate Bay, an arm of West Galveston Bay, about 12 miles north of San Luis Pass and 28 miles west of Galveston. The section under improvement extends from lower end of Chocolate Bay to the town of Liverpool, a distance of about 27 miles.

Existing project.—The river and harbor act approved March 2, 1907, added this improvement to others covered by the item for "Improving West Galveston Bay Channel, Tex., and mouths of adjacent streams." There being before Congress at the time of appropriation a recommendation (printed in H. Doc. No. 445, 56th Cong., 1st sess.) for a channel 4 feet deep at mean low time and 100 feet wide from West Galveston Bay across Chocolate Bay to 4 feet of water in the bayou, and for the removal of overhanging timber and snags, at an estimated cost of \$15,000, the project is assumed to include the work therein mentioned. The latest map is published in the project document. Tidal variation, about 1 foot.

Condition at the end of fiscal year.—The project is about 50 per cent completed. A channel 3 to 5 feet deep at mean low tide and 40 to 50 feet wide extends from West Galveston to mouth of the bayou, with a ruling depth on June 30, 1916, of 2½ feet. Snags and overhanging trees have been removed for a distance of about 24 miles and the stream is in good navigable condition. A total of \$24,313.30 has been expended on the improvement, of which \$6,512.12 was for new work and \$17,801.18 was for maintenance.

Effect of the improvement.—Affording water transportation to several small towns and rich farming community. Is also a feeder to the inland waterway on coast of Texas. No effect on rail rates.

Proposed operations.—The balance available on July 1, 1916, amounted to \$3,097.13, and it is proposed to use this amount and about \$3,500 of funds appropriated by the act of July 27, 1916, in operating one hydraulic pipe-line dredge for about five weeks, \$6,000, and one snag boat for two weeks, \$597.13, in the removal of shoals and snagging. It is expected that the available funds will be exhausted about December 31, 1916.

With the funds to be furnished under the estimate submitted in the report it is proposed to redredge the entire channel to project depth and to remove all snags and other obstructions by operating one United States hydraulic pipe-line dredge for about one month, \$5,000, and one United States snag boat for one month, \$1,200.

Commercial statistics.—The commercial statistics for 1915 were unobtainable. A large amount of hay and garden truck is moved over this waterway. The commerce for 1914 amounted to 6,167 tons, valued at \$96,180.

Amount expended on all projects from Mar. 2, 1907, to June 30, 1916:

New work	\$6,512.12
Maintenance	17,801.18
Total	24,313.30
July 1, 1916, balance available	3,097.13
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	6,200.00

(J) BASTROP BAYOU.

Proposed operations.—The sum of \$263.88 was available on July 1, 1916, and it is proposed to use this amount, together with about \$3,000 of the funds appropriated by the act of July 27, 1916, in the removal of shoals in channel with one United States hydraulic pipeline dredge working for about 20 days, which will exhaust the available funds about March 1, 1917.

As dredging will probably not be necessary during fiscal year 1918 no estimate for funds is submitted.

(K) OYSTER CREEK.

Location and description.—This creek has its source in Fort Bend County, about 20 miles southwest of Houston, and flows south a distance of about 50 miles, emptying into the Galveston and Brazos Canal, its former opening into the Gulf of Mexico having been closed. The section under improvement extends from the inland waterway to 5-foot depth in the bayou, a distance of about 3 miles.

Existing project.—The river and harbor act approved June 25, 1910, added this improvement to others covered by the item for "Improving West Galveston Bay Channel, * * * including mouths of adjacent streams." There being before Congress at the time of appropriation a recommendation (printed in H. Doc. No. 447, 56th Cong., 1st sess.) for a channel 4 feet deep at mean low tide from the Galveston-Brazos Canal to the same depth in the creek at a cost of \$5,000, the project depth is assumed to be that mentioned. The latest map is published in the project document. Tidal variation, about 1 foot.

Condition at the end of fiscal year.—The project was completed in fiscal year 1911. The ruling depth on June 30, 1916, was 5½ feet at mean low tide. A total of \$14,498.97 has been expended, of which \$6,942.24 was for new work and \$7,556.73 for maintenance.

Effect of the improvement.—Afforded an outlet for produce raised along the creek and inlet for supplies from Galveston and Houston.

Proposed operations.—The sum of \$22.15 is available on July 1, 1916, which will probably be expended for surveys, contingencies, etc., and be exhausted about December 31, 1916.

As this channel has been redredged during last fiscal year, it will probably not require any work during fiscal year 1917.

With the funds to be furnished under the estimate submitted in the report it is proposed to redredge the entire channel by operating one hydraulic pipe-line dredge for about two weeks at a cost of \$2,500.

Commercial statistics.—No statistics could be obtained for this stream for 1915. There is no record of commerce for 1913 or 1914.

Amount expended on all projects from June 25, 1910, to June 30, 1916:

New work	\$6, 942. 24
Maintenance	7, 556. 73

Total	14, 498. 97
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July 1, 1916, balance unexpended	22. 15
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Amount that can be profitably expended in fiscal year ending June

30, 1918, for maintenance of improvement	2, 500. 00
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Consolidated.

Amount expended on all projects from Sept. 19, 1890, to June 30, 1916:

New work-----	\$269, 877. 20
Maintenance-----	179, 847. 52
Total-----	449, 724. 72
July 1, 1916, balance unexpended-----	16, 155. 93
Balance available for fiscal year ending June 30, 1917-----	45, 538. 47
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	33, 300. 00

INLAND WATERWAY ON COAST OF TEXAS.

This project embraces the improvement of the following sections: West Galveston Bay and Brazos River Canal; channel between Brazos River and Matagorda Bay; channel from Aransas Pass to Pass Cavallo, including the Guadalupe River to Victoria. The last mentioned constitutes a branch channel or feeder of the inland waterway.

(A) WEST GALVESTON BAY AND BRAZOS RIVER CANAL.

Location and description.—This includes a channel from Galveston Harbor in a westerly direction through West Galveston Bay and Oyster Bay, and a canal connecting the latter with the Brazos River. The section is about 36 miles long, parallel to and from 1 to 4 miles distant from the coast line of the Gulf of Mexico.

Existing project.—Adopted by river and harbor act approved March 2, 1907, which combined the West Galveston Bay Channel and the Brazos River Canal under one appropriation as a part of the inland waterway on the coast of Texas, providing for a channel 5 feet deep at mean low tide and 40 feet wide on the bottom at an estimated cost of \$151,529, with \$20,000 annually for maintenance. (See H. Doc. No. 640, 59th Cong., 2d sess.) The tidal variation is about 1 foot.

Condition at the end of fiscal year.—The project was completed in fiscal year 1909 and has been dredged several times in maintaining a navigable depth. The ruling depth on June 30, 1916, was about 4 feet at mean low tide from Galveston Causeway to end of dredged cut in Christmas Bay and about 3½ feet thence to Brazos River. A total of \$256,441.96 has been expended, of which \$134,491.04 was for new work and \$121,950.92 for maintenance.

Local cooperation.—In 1851–1853 the Galveston & Brazos Navigation Co. dredged a canal about 6 feet deep at mean low tide and 100 feet wide through the mainland from the Brazos River to Oyster Bay, a distance of about 10 miles. The United States purchased this canal in December, 1902, at a cost of \$30,000. It is reported that the State of Texas in 1859 dredged channels through the reefs in West Galveston Bay and that the storm of 1875 practically obliterated them. The Gulf, Colorado & Santa Fe Railroad reimbursed the United States in the sum of \$1,018.39 for the removal of certain piling and material that obstructed the channel at site of their abandoned bridge near the causeway.

Effect of the improvement.—As a part of the general improvement of inland waterways, it has had a beneficial effect on freight rates to

the coastal towns and those on adjacent streams. And it also affords a safe inland passage for small boats and barge traffic. It is reported that the rates on commodities handled by water to the towns on the waterway are about 40 to 60 per cent less than the all-rail rate from Galveston.

Proposed operations.—It is proposed to use the balance of \$2,275.42 available on July 1, 1916, together with \$15,000 appropriated by the rivers and harbors act approved July 27, 1916, in maintaining the channel by operating one hydraulic pipe-line dredge for about three and one-half months at the rate of about \$5,000 per month, removing troublesome shoals, exhausting the available funds about June 30, 1917.

With the funds to be furnished under the estimate submitted it is proposed to maintain the channel by operating one United States hydraulic pipe-line dredge for three months—\$15,000.

Commercial statistics.—General merchandise, cotton, fish, and oysters constitute the principal items handled over this waterway. The record of vessels using this part of the inland waterway was obtained from the drawbridge tender at the Galveston Causeway. No detailed record of tonnage was obtainable. The traffic shown under section Brazos River to Matagorda Bay either originated at Galveston or was destined for Galveston. The Chocolate and Bastrop Bayous are also feeders of this waterway.

Comparative statement.

Calendar year.	Vessels.	Vessel tonnage.
1913.....	4,565	9,130
1914.....	5,236	26,180
1915.....	4,643	27,858

Amount expended on all projects from July 13, 1892, to June 30, 1916:

New work	\$233, 654. 42
Maintenance	125, 154, 89
Total	358, 809. 31

Balance available for fiscal year ending June 30, 1917..... 17, 275. 42

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 15, 000. 00

(B) CHANNEL BETWEEN BRAZOS RIVER AND MATAGORDA BAY.

Location and description.—This channel extends from the Brazos River, at the termination of the Galveston & Brazos Canal, to 5 feet of water in Matagorda Bay at mean low tide, a distance of about 32 miles, lying parallel to the coast line of the Gulf of Mexico, and one-half to 1½ miles distant therefrom. The east end is about 36 miles from Galveston and the west end about 114 miles north of Aransas Pass.

Existing project.—Adopted by river and harbor act of June 25, 1910, as a section of the inland waterway on the coast of Texas, which provided for a channel 5 feet deep at mean low tide, 40 feet wide on the bottom; at an estimated cost of \$400,000, with \$15,000

annually for maintenance. (See R. and H. Com. Doc. No. 3, 61st Cong., 2d sess.) The latest map is published in House Document No. 640, Fifty-ninth Congress, second session. Tidal variation about 1 foot.

Condition at the end of fiscal year.—This project was completed in fiscal year 1913. Channel has been partially redredged in maintaining navigable depth of 5 feet at mean low tide. Ruling depth on June 30, 1916, was about $3\frac{1}{2}$ feet at mean low tide, with an average depth of $4\frac{1}{2}$ feet at mean low tide. Total expended to end of fiscal year was \$337,664.50, of which \$246,549.21 was for new work and \$91,115.29 for maintenance. The original estimate for this canal was \$400,000, with an initial appropriation of \$200,000.

Local cooperation.—None; though use was made of the canal cut by private parties from Caney Creek into the upper end of Matagorda Bay.

Effect of the improvement.—The completion of this section of the canal has opened up a clear waterway from Galveston to Corpus Christi, a distance of 202 miles, developing considerable water-borne traffic, with a reduction of freight rates by water of 25 to 60 per cent of the rate charged by the railroads, but the volume has not been sufficient to effect any reduction of rail rates. Regular trips each week or 10 days are being made by light-draft gasoline boats between Galveston and points on the canal, and one self-propelling barge was in operation between Galveston and Corpus Christi the greater part of the year, until partly destroyed by fire.

Proposed operations.—It is proposed to use the balance of \$13,477.45 available on July 1, 1916, together with \$30,000 appropriated by the river and harbor act approved July 27, 1916, in redredging channel by operating one hydraulic pipe-line dredge for about eight months, at the rate of \$5,000 per month, which will exhaust the available funds about June 30, 1917.

With the funds to be furnished under the estimate submitted it is proposed to redredge the channel by operating one hydraulic pipe-line dredge for six months, \$30,000.

Commercial statistics.—Cotton, fish, oysters, and general produce coming east, and groceries and hardware going west, are the principal items moved over this section of the inland waterway. The statistics are compiled from records obtained by the bridge tenders.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	2,758	\$308,330
1914.....	2,226	370,035
1915.....	9,064	1,054,150

Amount expended on all projects from June 25, 1910, to June 30, 1916:

New work.....	\$246,549.21
Maintenance	91,115.29
Total	337,664.50

Balance available for fiscal year ending June 30, 1917.....	43,477.45
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	30,000.00

(C) CHANNEL FROM ARANSAS PASS TO PASS CAVALLO.

Location and description.—This channel is about 63 miles in length, extending from the west end of Matagorda Bay to Aransas Pass, passing through Espirtu Santo, San Antonio, Mesquit, and Aransas Bays, which are separated from the Gulf of Mexico by Matagorda and St. Joseph Islands.

Existing project.—Adopted by river and harbor act approved March 2, 1907, and provides for the dredging of a channel 40 feet wide and 5 feet deep at mean low tide from entrance to Turtle Cove, at Aransas Pass to Matagorda Bay at head of Pass Cavallo, a distance of about 63 miles, utilizing the lagoons between the islands and the mainland, at an estimated cost of \$65,850. (H. Doc. No. 640, 59th Cong., 2d sess.) The river and harbor act approved July 25, 1912, contains a provision authorizing the Secretary of War to change the route of the channel from Aransas Pass to Pass Cavallo so as to pass by the town of Port O'Connor, Tex., and to expend available funds for this work instead of maintaining the channel along its former route. Variation of water surface about three-fourths of a foot.

Condition at the end of fiscal year.—The project was completed in fiscal year 1909. The ruling depth on June 30, 1916, was about $3\frac{1}{2}$ feet, with an average depth of $4\frac{1}{2}$ feet at mean low tide over part of the dredged portions. Total expenditures were \$168,127.14, of which \$49,017.76 was for new work and \$119,109.38 for maintenance.

Local cooperation.—Prior to 1875 a small amount of dredging through the shell reefs obstructing navigation of these bays was made by or under the authority of the State of Texas. The necessary rights of way for new cut-off channel passing close to the town of Port O'Connor were furnished to the United States by local interests.

Effect of the improvement.—As a component part of the inland waterway system this channel has provided waterway communication between Galveston and Corpus Christi, a distance of 202 miles, and has reduced freight rates on commodities handled by water 40 to 60 per cent of the rate charged by the railroads. Owing to the shallow depth and instability of the channel at a few points, particularly at Port O'Connor where recently improved, it has not yet resulted in a reduction of rail rates.

Proposed operations.—It is proposed to use the balance of \$13,243.21 available on July 1, 1916, together with \$30,000 appropriated by the river and harbor act approved July 27, 1916, in dredging the channel, operating one hydraulic pipe-line dredge for about eight months at rate of about \$5,000 per month, exhausting the funds about June 30, 1917.

With the funds to be furnished under the estimate submitted it is proposed to maintain the channel by operating one hydraulic pipe-line dredge for about six months, \$30,000.

Commercial statistics.—The principal items carried over this section of the inland waterway are cotton, fish, oysters, hardware, and general merchandise. In addition to the tonnage shown, much of the traffic shown under section "Brazos River to Matagorda Bay" also used this section of the inland waterway.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	380	\$48,600
1914.....	4,979	215,730
1915.....	3,032	181,356

Amount expended on all projects from Mar. 2, 1907. to June 30.

1916:	
New work.....	\$49,017.76
Maintenance.....	119,109.38
Total.....	168,127.14
Balance available for fiscal year ending June 30, 1917.....	43,243.21
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	30,000.00

(D) GUADALUPE RIVER TO VICTORIA.

Location and description.—This river has its source in western Texas and flows southeast a distance of about 250 miles, where it empties into the head of San Antonio Bay. The section under improvement is from Victoria to the mouth, a distance of 52 miles, and 16 miles across San Antonio Bay to connection with inland waterway.

Existing project.—Adopted by the river and harbor act approved March 2, 1907, which provided for dredging of channel in the bay section 5 feet deep at mean low tide and 40 feet wide and the removal of snags, log rafts, and the dredging of shoals between the mouth of the river and Victoria, at a total estimated cost of \$92,700. (H. Doc. No. 338, 59th Cong., 2d sess.) The latest map is published in House Document No. 1090, Sixty-fourth Congress, first session. Tidal variation about three-fourths of a foot in San Antonio Bay.

Condition at the end of fiscal year.—The project was completed in fiscal year 1912. The channel across San Antonio Bay had a ruling depth of over 5 feet at mean low tide on June 30, 1916, and the shoalest depth over gravel bars on the river section was 2½ feet at ordinary stage of water. Snags and overhanging trees have been removed, but each freshet brings in additional obstructions. A total of \$276,970.58 has been expended, of which \$172,547.28 was for original work and construction of the snag boat *Guadalupe* and \$104,423.30 was for maintenance. The increased cost of the work was due to underestimate of amount of dredging in river section and to construction of the dredge and snag boat *Guadalupe* at a cost of \$39,343.63.

Effect of the improvement.—Afforded waterway for handling products from farms to Victoria along the upper section and connection with the inland waterway. It has had no effect as yet on freight rates by reason of the desired through depth not yet having been obtained at any one time.

Proposed operations.—In view of the recommendation against further expenditures in improvement of Guadalupe River, transmitted to Congress in a report printed in House Document No. 1090, Sixty-fourth Congress, first session, with map, it is proposed to expend the \$296.11 available July 1, 1916, with about \$600 appropriated by the

river and harbor act approved July 27, 1916, in caring for Government plant, reserving the balance of funds appropriated by the act of July 27, 1916, \$22,900, until action is taken by Congress.

Pending action by Congress on the recommendation mentioned no estimate for this improvement for the fiscal year ending June 30, 1918, is submitted.

Commercial statistics.—Sand and gravel are the principal items moved over this waterway.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	109,823	\$64,701
1914.....	63,754	39,947
1915.....	63,119	36,040

Amount expended on all projects from Mar. 2, 1907, to June 30,

1916:

New work.....	\$172,547.28
Maintenance.....	104,423.30
Total.....	276,970.58
Balance available for fiscal year ending June 30, 1917.....	23,796.11

CONSOLIDATED.

Amount expended on all projects to June 30, 1916:

New work.....	\$701,768.67
Maintenance.....	439,802.86
Total.....	1,141,571.53
Balance available for fiscal year ending June 30, 1917.....	127,792.19
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	75,000.00

MOUTH OF BRAZOS RIVER, TEX.

Location and description.—The Brazos River rises in the northwest portion of Texas and flows in a southerly direction for about 950 miles, emptying into the Gulf of Mexico 50 miles southwest of the Galveston entrance and 141 miles east of Aransas Pass. The section improved under this title includes about 6½ miles at the mouth.

Existing project.—(See Freeport item following.)

Condition at the end of fiscal year.—Two parallel jetties had been built and repaired at various times, and a channel 150 feet wide and 18 feet deep at mean low tide had been dredged between the jetties, completing the project. A total of \$603,878.40 had been expended, of which \$392,073.99 was for new work and \$211,804.41 was for maintenance, including \$99,752.39, one-half of cost of new dredge *Comstock* charged to this improvement. Ruling depth on June 30, 1916, was 18 feet at mean low tide.

Local cooperation.—After suspension of the work by the United States in 1889 the work of improvement was undertaken by the Brazos River Channel & Dock Co. under authority granted by Congress on August 9, 1888. This company built the north jetty for a

distance of 4,708 feet, and the south jetty 5,018 feet, and several wing dams or spur dikes along bank of river to control the current. The company transferred all their works, rights, and privileges, etc., to the United States on April 25, 1899, after having obtained a depth of about 14.3 feet at mean low tide over the bar at a total expenditure, according to figures furnished by them, of \$1,449,025.

Effect of improvement.—Regular sailings of four to six vessels per month are now made by steamers of the Seaboard & Gulf Steamship Co. between Freeport, a new town just below Velasco, and New York. This traffic has had some effect on the freight rates of competing lines to Galveston.

Proposed operations.—With the funds available on July 1, 1916, amounting to \$26,377.94, it is proposed to maintain the channel by operating one seagoing dredge for about four months, and it is expected that the available funds will be exhausted about December 31, 1916.

It is proposed to use the funds appropriated by the act of July 27, 1916, in maintenance of channel by operating one seagoing dredge for about seven months, \$40,000. and one hydraulic pipe-line dredge for about three months, \$30,000: and to repair the jetties, \$105,000.

With the funds to be furnished under the estimate submittted in the report it is proposed to maintain the channel by operating one sea-going dredge for about six months, \$36,000, and one hydraulic pipe-line dredge for three months, \$30,000.

Commercial statistics.—The commerce consisted principally of sulphur, fuel oil, ammunition, and general merchandise. The Freeport Sulphur Co. advises that 90,000 tons of sulphur, valued at \$1,800,000, has been diverted from steamer shipment to all-rail shipment owing to inadequate depth for steamers suited for this traffic.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	24,575	\$4,004,544
1914.....	101,515	7,513,099
1915.....	149,335	5,746,466

Amount expended on all projects from June 14, 1880. to June 30.

1916:	
New work.....	\$539,172.42
Maintenance.....	211,804.41
Total	750,976.83
Balance available for fiscal year ending June 30, 1917.....	201,377.94
Amount that can be profitably expended in fiscal year ending June 30, 1918. for maintenance of improvement.....	66,000.00

FREEPORT HARBOR, TEX.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1469, Sixty-third Congress, third session:

The existing project for the improvement of the mouth of the Brazos River is to repair and strengthen the two parallel jetties formerly built by a private company and turned over to the United States in 1899, construct spur dikes and

bank protection, and to dredge a channel 18 feet deep and 150 feet wide. A channel of the adopted dimensions has been secured for short periods, but owing to the sudden rises to which the stream is subject and the consequent shoaling of the channel the project depth has never been maintained for such a length of time that shipping interests could confidently rely upon it. The act of March 4, 1913, made an appropriation for a new seagoing dredge for use jointly at Aransas Pass and the mouth of Brazos River, to replace the dredge *Comstock*, which was destroyed by fire. This new dredge, while adequate for the maintenance of the outer end of the channel beyond the jetties and for some distance between them, is not suitable for the economical prosecution of work in the river proper, and for this reason the district officer states that the project depth can not be maintained by the use of a seagoing suction dredge alone, but will require a hydraulic pipe-line dredge in addition for use in the river channel and in the upper part of the jetty channel. If economical ocean carriers are to be accommodated, a minimum of 21 feet will be required, and he believes that the plant mentioned above will be able to maintain a depth of from 22 to 25 feet in the entrance and up as far as the present steamship wharf. The estimated cost of the proposed improvement is \$500,000, which includes the cost of one 20-inch hydraulic pipe-line dredge, operating the same for one year and a half, operating new seagoing dredge *Comstock* during two years, minor repairs to jetties, etc. Maintenance is estimated at \$150,000 annually. Extension of the jetties is not recommended. The district officer believes that the present and prospective commerce involved and the benefits to be expected amply justify the method of procedure proposed. He therefore expresses the opinion that the mouth of Brazos River is worthy of improvement for 25 feet depth, or as near that depth as can be maintained with the plant proposed, but recommends that operations for the present be confined to obtaining this depth up to the present steamship wharf, and that the depth be extended farther upstream and if necessary to Freeport when additional terminal facilities have been provided. The division engineer concurs in general with the views of the district officer.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated December 9, 1914. The board is not convinced that the commercial necessities warrant at this time the cost of purchasing and operating the 20-inch dredge recommended by the district officer, but it does believe that the immediate and prospective benefits to commerce warrant the purchase of a 15-inch suction dredge, which could be used advantageously on other works in case its services are not required on the Brazos. Such a dredge will probably be sufficient to provide a reasonably permanent channel about 22 feet in depth from the jetties up to the present wharf and leave some time which can be devoted to the maintenance of the intracoastal canal adjacent to the river, and perhaps for such extension of the project upstream toward the town of Freeport as may be found desirable. With the smaller dredge proposed by the board the estimated cost of the improvement is \$455,000, including operation of the suction dredge for three years, and of the seagoing dredge engaged on this work one-half the time during a similar period. The cost of subsequent maintenance, if the port develops sufficient commerce to justify continuance, is estimated at \$100,000 annually. Contingent upon certain conditions the board recommends the further improvement of the locality in accordance with this plan.

I concur in the views of the Board of Engineers for Rivers and Harbors and therefore report that the further improvement by the United States of the mouth of Brazos River is deemed advisable under a modified project providing for the purchase of one 15-inch suction dredge, its operation for a period of three years, the operation of the seagoing dredge already authorized one-half time during a period of three years, and repairs to jetties, all at an estimated cost of \$455,000, and \$100,000 annually thereafter for maintenance, if this is deemed advisable after the experimental period of three years, subject to the conditions recommended by the board as specified in paragraph 12 of its report dated December 9, 1914.

CHANNEL FROM ARANSAS PASS TO CORPUS CHRISTI, TEX.

Location and description.—This channel extends from Aransas Pass, through the depression known as Turtle Cove, and Corpus

Christi Bay, to the town of Corpus Christi on the west side of the bay, a distance of $21\frac{1}{2}$ miles west of Port Aransas.

Existing project.—The existing project was adopted by river and harbor act approved June 25, 1910, and provided for the deepening of the channel from $8\frac{1}{2}$ to 12 feet at mean low tide and widening from 75 feet to 100 feet on the bottom from Aransas Pass through Turtle Cove Channel to Corpus Christi, ending in a turning basin 1,000 feet square and 12 feet deep at mean low tide, at an estimated cost, including \$50,000 for the construction of a dredge for maintenance, of \$207,000 with \$35,000 annually for maintenance. (H. Doc. 678, 61st Cong., 2d sess.) The tidal variation is about 1 foot. The latest map is printed in House Document No. 338, Fifty-ninth Congress, second session.

Condition at the end of fiscal year.—The project has been completed. The ruling depth on June 30, 1916, was $9\frac{1}{2}$ feet at mean low tide in the channel and 10 feet in the turning basin. A total of \$177,146.69 has been expended, of which \$157,903 was for new work and \$19,243.69 was for maintenance.

Local cooperation.—In 1874 a channel was dredged by Messrs. Morris & Cummings, under an agreement with the State of Texas, extending from Aransas Bay to Corpus Christi Bay, passing through the shallow flats behind Harbor Island. This cut was about 8 feet deep at mean low tide and 100 feet wide and about 6 miles long. Its use has practically been discontinued. The city of Corpus Christi has provided a municipal wharf about 200 feet wide and 1,000 feet long at turning basin in front of the city, at a cost of about \$50,000.

Effect of the improvement.—The effect of the improvement has been to place the city of Corpus Christi in water communication with ocean-going traffic at Port Aransas and permitted establishment of regular light-draft steamship service to Galveston. The freight rates on commodities handled by water are about 40 to 60 per cent less than the rail rates between common points, but traffic is not yet in sufficient volume to effect a material reduction of railroad rates.

Proposed operations.—It is expected that the available funds will be sufficient for necessary work of maintenance to June 30, 1918, and no estimate for additional funds is submitted.

Commercial statistics.—The figures for 1913 are incomplete. The principal items of commerce are cotton, fuel oil, canned goods, and groceries.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	10,849	\$75,943
1914.....	64,455	1,530,123
1915.....	26,803	2,479,358

Increase in valuation of the 1915 commerce is due to a more detailed statement of the commerce.

Financial summary.

Amount expended on all projects from Mar. 2, 1907, to June 30, 1916:

New work-----	\$280, 455. 14
Maintenance-----	23, 415. 12
Total-----	303, 870. 26
Balance available for fiscal year ending June 30, 1917-----	30, 756. 13

Statement of Col. H. C. Newcomer, Corps of Engineers, before the Committee on Rivers and Harbors, January 8, 1917:

The funds on hand for the maintenance of the channel from Aransas Pass to Corpus Christi at the beginning of the fiscal year were supposed to be sufficient to have maintained the project until the end of the fiscal year 1918, but the storm of August, 1916, damaged the channel very severely, requiring the immediate use not only of all the available funds, but of an additional emergency allotment, and the district officer has since submitted an estimate of \$25,000 for maintenance in the fiscal year 1918.

SABINE-NECHES CANAL, INCLUDING SABINE RIVER TO ORANGE AND NECHES RIVER TO BEAUMONT, TEX.

Location and description.—This waterway is in the extreme southeastern portion of Texas. It extends from the Port Arthur Canal near its upper end to Sabine River near its mouth, crossing the Neches River near its mouth, and up the Neches River to Beaumont and the Sabine River to Orange. Distances are as follows: Port Arthur Canal to the Neches River, 12 miles; thence to Beaumont, 23 miles; Neches River to Sabine River, 4 miles; thence to Orange, 10 miles. The Sabine River rises in northeast Texas and flows southeasterly approximately 550 miles to Sabine Lake, entering the lake through three passes. The Neches River rises in northeast Texas and flows southeasterly approximately 300 miles to Sabine Lake.

Existing project.—The existing project, adopted by the river and harbor act approved February 27, 1911, and modified by the river and harbor acts of July 25, 1912, and March 4, 1915, provides for a waterway from the Port Arthur Ship Canal to Beaumont and Orange, with 25-foot depth at mean low Gulf level throughout and bottom widths as follows: In the canal from the Port Arthur Ship Canal to Sabine River, 90 feet through the land, suitably widened where it enters the rivers, and 115 feet where it crosses the open lake between the mouths of the Sabine and Neches Rivers; in open rivers, 150 feet; in the two cut-offs in the Neches River, at Mansfield Ferry and Snaggy Bend, 90 feet; in the cut-off in the Sabine River, 210 feet. It further includes a guard lock 80 by 600 feet, with a depth of 28 feet over miter sills, 6 miles above Port Arthur; three passing points 110 by 1,700 feet in the canal below the Neches River; a turning basin 500 by 1,500 feet at Beaumont, and one at Orange. The mean tidal variation is about 1 foot in the canal and 0.5 foot at Orange and Beaumont. The total estimated cost was \$1,143,000, with \$50,000 annually for maintenance, exclusive of the cost of maintenance and operation of the lock. (See H. Doc. No. 1290, 61st Cong., 3d sess.) For map see House Document No. 836, Sixty-first Congress, third session.

Condition at the end of fiscal year.—The project was completed during this fiscal year to full dimensions, the controlling depth at the end of the year being 25 feet at mean low Gulf level. The total expenditure was \$1,153,680.52, of which \$1,149,249.96 was for new work and \$4,430.56 for maintenance. The guard lock was fully completed on June 30, 1916, the cost being \$222,687.11. On sections A and C the full amount of the authorized cost has been expended plus \$7,455 additional contributed by the Beaumont navigation district of Jefferson County, but considerably more work has been accomplished than was originally contemplated. Section B, including a wider channel than originally planned through the lake section and in the cut-off in the Sabine River was completed for \$1,843.14 less than the estimate.

Local cooperation.—The conditions imposed by law required the Beaumont navigation district, or other local interests and the Orange navigation district, or other local interests, to furnish free of cost to the United States the necessary right of way for the improvement and to contribute one-half of the estimated cost of the project, namely, \$428,000 and \$143,500, respectively. The law also provided that the Beaumont navigation district or other local interests should become bound in manner satisfactory to the Secretary of War to maintain for three years following completion sections A and C and to maintain the guard lock without cost to the United States until otherwise provided by law; and that the Orange navigation district or other local interests should likewise become bound to maintain section B for a period of three years following its completion. All of these conditions were met. The Beaumont navigation district of Jefferson County, Tex., deposited the sum of \$428,000 in June, 1911, and the Orange County navigation district the sum of \$143,500 in October, 1911. The Secretary of War approved the bond for maintenance of sections A and C May 31, 1911, the deeds for right of way for sections A and C October 23, 1911, the bond for maintenance of section B November 21, 1911, and the deeds for right of way for section B June 13, 1912. The act of March 4, 1915, relieves the Beaumont navigation district or other local interests from maintaining for three years the portion of the channel from the Port Arthur Canal to the Neches River. To cover certain work in the Beaumont Turning Basin not otherwise provided for the Beaumont navigation district of Jefferson County, Tex., contributed an additional sum of \$7,500 in February, 1915, which amount was accepted under the authority of section 8 of the river and harbor act of March 4, 1913. Of this amount the unexpended balance of \$810.67 was returned. In May, 1916, also, that district contributed \$1,000 toward the cost of widening the channel at a bend in the Neches River about 7 miles below Beaumont, which amount was accepted under the provisions of section 4 of the river and harbor act of March 4, 1915. Of this amount the unexpended balance of \$234.33 will be returned.

Effect of improvement.—This improvement has permitted deep draft ocean-going vessels to go to Beaumont and Orange, and has resulted in saving the cost of lighterage in large quantities of oils and lumber. A further result has been that Beaumont has been placed on a parity with other Gulf ports as to freight rates on export and im-

port traffic from Chicago, St. Louis, Kansas City, and other commercial centers. The Railroad Commission of Texas states that there have been no changes in Texas intrastate rates "that could be attributable to the deepening of these channels, and, so far as we can now say, no changes in rates are contemplated on that account."

Proposed operations.—The portion of the project, the maintenance of which now devolves upon the United States, is that portion of the canal from its junction with the Port Arthur Ship Canal to the mouth of the Neches River, a distance of about 12 miles. With the funds now available it is proposed to operate the United States hydraulic pipe-line dredge *Orange* three to four months in redredging the channel to remove shoaling when conditions require it. It is expected that this work will exhaust these funds by the end of the fiscal year 1917. With the funds to be furnished under the estimate now submitted it is proposed to similarly operate the dredge *Orange* three to four months during the fiscal year 1918. Shoaling of this portion of the canal has occurred since it was first dredged and it is anticipated that this will continue indefinitely, although the yearly amount may gradually decrease. The only previous expenditure for maintenance has been that from the \$5,000 allotted from the river and harbor act approved March 4, 1915, for the portion of the canal above the guard lock.

Commercial statistics.—This commerce is miscellaneous freight, consisting principally of crude petroleum and its refined products, lumber, sand, shell, and general merchandise.

Comparative statement.

Calendar year.	Sabine River.		Neches River.		Sabine-Neches Canal.	
	Short tons.	Value.	Short tons.	Value.	Short tons.	Value.
1913.....	443,989	\$3,208,479	221,519	\$1,711,832	629,001	\$3,846,752
1914.....	505,271	3,159,496	157,797	1,278,305	679,319	3,607,957
1915.....	541,260	3,876,957	295,985	1,843,407	543,157	4,723,692

The increase in tonnage in the Sabine River is mainly in crude oil. In the Neches River there was a decrease in lumber shipments, but large increases in logs, crude oil, and sand. In the Sabine-Neches Canal the decrease in tonnage is mainly in the item of oyster shells, while the increase in value is due to larger shipments of crude oil.

Amount expended on all projects from June 18, 1878, to June 30, 1916:	
New work.....	\$1,149,249.96
Maintenance.....	4,430.56
Total.....	1,153,680.52
July 1, 1916, balance unexpended.....	2,077.47

MAINTENANCE OF SECTION A.

Balance available for fiscal year ending June 30, 1917.....	\$20,567.75
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	20,000.00

COLORADO RIVER, TEX.—NEW PROJECT.

Abstract from the report of the Chief of Engineers printed in Rivers and Harbors Committee Document 3, Sixty-third Congress, first session:

The Colorado River has its sources in Dawson, Martin, and Midland Counties. After traversing about 450 miles of country it discharges into Matagorda Bay, which is distant from Pass Cavallo about 35 miles. Pass Cavallo is the channel connecting the bay with the Gulf of Mexico.

I concur in general with the district officer and the board of engineers for rivers and harbors in the opinion that for the section of river from mile 21 to Bay City the benefits to be derived from the improvement are not commensurate with the expense that would be entailed, and it is therefore considered that this section is not worthy of improvement by the Government at the present time. For the section from a connection with the Intercoastal Canal in Matagorda Bay to mile 21 in the river I concur with the district officer in the opinion that the improvement can be made at a reasonable cost in comparison with the benefits derived; and in view of the offers of local cooperation as to bridges and terminal facilities, I recommend that the locality be improved by the United States to the extent of redredging a channel 5 feet deep and 40 feet wide across the bar at the mouth and snagging, removing remains of old rafts, and cutting overhanging timber from the mouth to mile 21, at a total estimated cost of \$25,000, on condition that the improvement be not undertaken until after the construction of a railroad spur to some point at or near mile 21, and a public wharf on each side of the river at this place, with public roads leading thereto, and suitable bridge draws in the bridges below mile 21, satisfactory to the Chief of Engineers and to the Secretary of War, all free of expense to the United States.

CYPRESS BAYOU AND WATERWAY BETWEEN JEFFERSON, TEX., AND SHREVEPORT, LA.

Location and description.—Cypress Bayou rises in northeast Texas, flows slightly southeastward approximately 119 miles to Caddo Lake, thence approximately 17 miles across Caddo Lake to Big Willow Pass, thence approximately 26 miles through Big and Little Willow Passes, Soda Lake, and Twelvemile Bayou to Red River just above Shreveport, a total distance of about 162 miles. That portion between Jefferson, Tex., and Red River, about 68 miles, is included in the project.

Existing project.—This project, adopted by the river and harbor act of June 10, 1872, at an estimated cost of \$20,000, is to provide a navigable channel from Jefferson, Tex., to the Red River at Shreveport, La., by way of Cypress Bayou and connecting waters, by dredging and straightening the channel (no dimensions given), removing stumps, logs, snags, and other obstructions, and clearing the banks (see Annual Report for 1872, p. 572), and to construct a dam without lock at the foot of Caddo Lake, at an estimated cost of \$100,000, as authorized by the river and harbor act approved June 25, 1910. (See H. Doc. No. 220, 60th Cong., 1st sess.) For map, see House Document No. 236, Sixty-third Congress, first session.

Condition at the end of fiscal year.—Dredging and snagging operations were carried on by hired labor during the period 1873–1880, and the work was then reported as finished, seven cut-offs having been made, and the distance from Shreveport to Jefferson having been reduced by approximately 30 miles, at an expense of \$89,650.96. Since that date there have been expended \$12,613.05 for surveys during the period 1890–1896, \$78,500.84 for maintenance of open-channel work,

and \$100,553.47 for the construction of the dam at the foot of Caddo Lake, completed December 21, 1914. The removal of the raft, 1872-73, and the subsequent closure of outlets and construction of levees down the right bank of Red River from the hills in Arkansas to near Shreveport, La., cut off the water supply of the lakes, which, in conjunction with the quicker drainage resulting from the lowering of the bed of Red River, gradually reduced their depth. In consequence, the period of navigation shortened from year to year until 1897, when boats from Red River ceased plying altogether. The construction of the dam at the foot of Caddo Lake insures a 4-foot navigable depth at low water from that point to Jefferson, but cuts off all possible navigation to Shreveport except for such light-draft boats as may pass over the dam at high stages. Below the dam navigation is largely dependent on back water from the Red River. A stage of 15-24 feet on the Shreveport gauge, depending on the amount of water coming from the Cypress Bayou drainage area, is necessary to provide a 4-foot depth up to the dam. Such stages are short in duration and irregular in occurrence. High-water stages usually occur from February to July. The total expenditure to the end of the fiscal year was \$281,318.32, of which \$202,817.48 was for new work and \$78,500.84 for maintenance.

Local cooperation.—Prior to the beginning of work by the United States the citizens of Jefferson had expended over \$70,000 (Annual Report for 1880, p. 1280) on the channel in the vicinity of that city. The city also loaned to the United States, free of cost, the dredge which it had been operating.

Effect of improvement.—Under conditions now existing the work formerly done below Caddo Lake is of no benefit. The construction of the dam and the channel work above have facilitated navigation in the upper section, providing means for the transportation of commodities between the railroad at Mooringsport and Jefferson and points on Caddo Lake and James Bayou. There has been no effect on rail rates.

Proposed operations.—The funds now available will be expended in caring for and operating the U. S. quarterboat *No. 2* for the maintenance of the channel from Jefferson to the dam. The operation of this boat costs about \$600 per month, and it is expected that it will be operated about eight months and then laid up, all funds being exhausted by June 30, 1917.

With the funds to be furnished under the estimate now submitted, it is proposed to similarly operate this boat about eight months in the fiscal year 1918 for the maintenance of the channel from Jefferson to the dam. The yearly expenditure of about \$5,000 is required to keep the channel clear. This amount is larger than the average expenditures during the preceding three years, but these have been insufficient to fully maintain the channel.

Commercial statistics.—The commerce consists, in general, of lumber, machinery, and equipment for oil wells and general merchandise and supplies. The decrease in the tonnage for 1915 is due partly to the fact that a number of the items reported for 1914 were for the construction of the dam, which is now finished, and partly to the fact that there have been omitted from these statistics items of crude oil, etc., which were merely ferried across the waterway. Such items were included in the statistics for prior years.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	44,475	\$996,103
1914.....	32,990	956,530
1915.....	11,444	641,361

Amount expended on all projects from June 10, 1872, to June 30.

1916:

New work.....\$202,817.48
Maintenance.....78,500.84

Total.....281,318.32

Balance available for fiscal year ending June 30, 1917.....5,582.12

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....5,000.00

OUACHITA AND BLACK RIVERS, ARK. AND LA.

Location and description.—Ouachita River rises in Polk County, Ark., and flows in a general southeasterly direction through Arkansas and Louisiana. It is joined by Tensas and Little Rivers at Trinity, La., below which place it is called Black River, and flowing thence south, enters Red River 34 miles above its mouth. Ouachita River is about 500 miles long and Black River is 56.8 miles long.

Existing project.—This project is based on plan contained in House Document No. 448, Fifty-seventh Congress, first session (Annual Report for 1902, p. 1435), which proposed to obtain a navigable depth of 6½ feet at low water from the mouth of Black River, La., to a point about 10 miles above Camden, Ark., a distance of 360 miles, by the construction of nine locks and dams, at an estimated cost (as revised) of \$4,876,654.35. This plan has never been adopted in its entirety by Congress, but the construction of Locks and Dams Nos. 4 and 6 was authorized by river and harbor act approved June 13, 1902; Nos. 2 and 8 by act of March 2, 1907; acquisition of sites for Nos. 3 and 7 by act of June 25, 1910, and their construction by act of July 25, 1912. The construction of Locks and Dams Nos. 5 and 9 has not yet been authorized by Congress, and No. 1 was eliminated from the plan by the Secretary of War under authority of river and harbor act of March 2, 1907.

In addition to the construction of locks and dams work is being continued for maintenance of the previous project for open-channel improvement by removing snags, logs, wrecks, overhanging trees, etc., at an estimated cost of \$25,000 per annum. The latest published map of the section of these rivers included in the project was in the annual report for 1913.

Condition at the end of fiscal year.—The work has consisted of removing snags, logs, etc., obstructing navigation, dredging a rock and gravel bar at Catahoula Shoals, and building locks and dams. Snagging operations and dredging have greatly improved navigation at high and mean stages. From July to December water stages are usually low and the maximum draft that can be carried in the open river is 3½ feet to Harrisonburg, La., 72.8 miles above mouth of

Black River: $1\frac{1}{4}$ feet to Monroe, La., 183.3 miles; and 8 inches to Camden, Ark., 350.8 miles. These stages are about 1 to 3 feet on the Monroe gauge. When this gauge reads 10 feet or more (the stage resulting from head water, not back water), which ordinarily is the case between January and June, boats drawing 6 feet or more can run between mouth of Black River and Camden. The operating parts of Locks and Dams Nos. 4, 6, and 8 were completed as follows: No. 4, January 1, 1915; No. 6, January 25, 1913; No. 8, October 1, 1912; and these are now in operation, providing pools at low water from 23 to 30 miles long, with least depths of $6\frac{1}{2}$ feet. These pools are not continuous. The completion of the project requires finishing Dam No. 2, Lock and Dam No. 3, a small amount of work at Nos. 6 and 8, and practically the entire construction of No. 7. Work for maintenance can not be completed. Locks and Dams Nos. 5 and 9, which were part of the original plan, have not been authorized by Congress. Lock and Dam No. 4 was finished during the fiscal year at a total cost of \$649,630.23. Lock and Dam No. 2 is 68 per cent completed; No. 3, 35 per cent; No. 6, $99\frac{1}{2}$ per cent; No. 7, 1 per cent; and No. 8, $99\frac{1}{2}$ per cent. The expenditures under the existing project to end of the fiscal year have been \$2,833,438.08, of which \$2,546,994.19 was for new work and \$286,443.89 for maintenance.

Effect of improvement.—The work done has made navigation easier and safer at stages when boats can run, and has made all-the-year-round $6\frac{1}{2}$ -foot navigation possible in three isolated pools. Freight rates have been considerably reduced by the improvement.

Proposed operations.—It is estimated that the maintenance of improvement by open-channel work to June 30, 1918, will cost about \$49,000, thus requiring an additional appropriation of \$10,000, and an estimate for this sum is submitted.

Such portion as may be required of the balance available for lock and dam construction will be applied to completing projects for Locks and Dams Nos. 2, 3, 6, and 8. The estimated expenditures are as follows:

Lock and Dam No. 2:	
Superintendence and inspection of work under contract and contingencies	\$67, 562. 30
Maneuvering boat and equipment	7, 000. 00
Lock and Dam No. 3:	
Completion of lock	170, 000. 00
Completion of dam	120, 000. 00
Maneuvering boat and equipment	7, 000. 00
Permanent buildings	5, 000. 00
Superintendence, care of plant, and contingencies	9, 528. 46
Lock and Dam No. 6, constructing telephone line	2, 470. 54
Lock and Dam No. 8, constructing telephone line	2, 451. 10

Construction work will begin at Locks and Dams Nos. 2 and 3 as soon as the river reaches a favorable stage, and will be continued until the projects are completed, probably before March 1, 1917, if not stopped by rising water. The telephone lines at Locks and Dams Nos. 6 and 8 will probably be erected before December 1, 1916.

The construction of Lock and Dam No. 7 is being delayed temporarily pending the consideration of certain matters pertaining to this work and the necessary collection of construction materials.

Commercial statistics.—All commerce on these streams will be directly benefited by the completion of the improvement.

Comparative statement.

Fiscal year ending June 30.	Short tons.	Value.
1914.....	64,874	\$1,923,231
1915.....	70,619	3,074,465
1916.....	97,451	2,108,146

The freight carried during the current fiscal year consisted of lumber and logs, farm products, and general merchandise.

Amount expended on all projects from March 3, 1871 to June 30.

1916:	
New work	\$3,152,796.38
Maintenance	286,443.89
Total	3,439,240.27
Balance available for fiscal year ending June 30, 1917.....	672,886.11
Amount (estimated) required to be appropriated for completion of existing project.....	1,615,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	10,000.00

ARKANSAS RIVER, ARK. AND OKLA.

Location and description.—This river has its source in the Tennessee Pass, in central Colorado, whence it flows in a general southeasterly direction to the Mississippi River, into which it empties near the southeastern corner of the State of Arkansas. The project includes the section below the mouth of the Neosho (Grand) River, 461 miles. The total length is 1,460 miles, the drainage area 151,000 square miles.

Existing project.—The present project provides for (a) improving the river from its mouth to the head of navigation by snagging operations, removing shoals by dredging, and the use of contraction works, and holding the improved channel by revetment where necessary; (b) the tentative use of two dredges on that part of the river between the mouth and Ozark, 318 miles, to determine the practicability of permanently improving navigation by means of dredging; and (c) the maintenance of existing works, including those at Pine Bluff, Ark.

The combined project (a) for snagging and permanent works for the entire river is held to date from 1902, the river and harbor act of that year having made an appropriation for such general improvement, including provisional authority for use of dredge boats, but without reference to any definite plan of improvement or estimate of cost. In the absence of plans adapted to the construction of permanent works and of funds in sufficient amount to undertake any improvements of that character, work under this project has been confined almost exclusively to snagging operations with Government plant, and a small amount of experimental dredging prior to 1910 with plant loaned by the Mississippi River Commission.

The tentative project (b) for use of two dredges between the mouth of the river and Ozark was authorized by the river and harbor act approved June 25, 1910, in accordance with reports printed

in House Document No. 71, Sixty-first Congress, first session, and House Document No. 510, Sixty-first Congress, second session, at an estimated cost of \$349,000 for plant and \$118,700 annually for its operation. The object of this experimental work is to aid and encourage navigation and to determine the effectiveness of improving the channel by this method.

In addition to the revetment built at Pine Bluff under prior appropriations as a part of the works for permanent improvement of the river, recent river and harbor acts have made provision for the maintenance of the levee built under authority of the act of March 2, 1907, for the purpose of preventing a cut-off at that place. (See H. Doc. No. 71, 61st Cong., 1st sess.) These works are, therefore, included among those to be maintained under the present project (c).

Condition at the end of fiscal year.—Contraction works and bank revetment, having in view the permanent improvement of the river, have been placed in 12 localities, and at Moores Rocks a channel was made by blasting. Except for the maintenance of the harbor at Pine Bluff no single improved reach was of sufficient length to be of material assistance to river navigation; local benefits, due to the local fixation of the channel, have accrued in some cases. At the present time the bank revetment and levee at Pine Bluff are the only permanent works that are being maintained. So far as the project contemplates the use of contraction works and revetment to hold the improved channel it is less than 5 per cent completed. Dredging operations have been limited to the portion of the river below Pine Bluff. One dredge was used during the fiscal year 1915 and two dredges during the past year. During the past year the river was abnormally high throughout the season when low waters may normally be expected. No material benefits have so far resulted from the operation of these dredges. Snagging operations are prosecuted as continuously as available funds permit. These make navigation safer and easier, but outside of the permanent reaches the benefits are soon lost by reason of the additional obstructions brought into the river and the shifting of channels following the caving of banks, nevertheless there is a continuous slow improvement in channel conditions in this respect. In December, 1915, while the reading on Weather Bureau gauge at Little Rock was 4.7 feet, the lowest stage during the fiscal year, $3\frac{1}{2}$ feet draft could be brought from the mouth of the river to Pine Bluff and 3 feet draft could be brought to Little Rock. Under average conditions 4 feet draft can be brought from the mouth of the river to Little Rock from the middle of February to the middle of July. Beginning with the latter part of August and continuing to the 1st of December the draft is limited to about 2 feet. In years of prolonged drought navigation is suspended because of insufficient channel depth.

The total expenditures under the existing project to June 30, 1916, are:

New work:

Construction of revetment in Trusty Bend.....	\$60,000.00
Construction of levee near Pine Bluff.....	55,200.00

Total for new work.....	\$115,200.00
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Maintenance:

Maintenance of original permanent works, excepting those at Pine Bluff-----	\$18,771.73
Maintenance of works at Pine Bluff—	
Levee-----	7,760.99
Revetment-----	247,267.84
Hydraulic dredging:	
Prior to 1910-----	43,866.89
1910 project-----	531,133.78
Operating snag boats-----	357,260.01
Total for maintenance-----	\$1,206,061.24
Total under existing project to June 30, 1916-----	1,321,261.24

Effect of improvement.—There has been no material effect on freight rates. Snagging operations have made the natural depths available. The works at Pine Bluff have so far maintained the integrity of that harbor.

Proposed operations.—The funds available for expenditure during the fiscal year 1917 will be applied to operating snag boats throughout the low-water season and to their care and repair during the high-water period of the fiscal year ending June 30, 1917; to maintaining the works at Pine Bluff where the repairs will be completed about October 15, 1916; to operating two suction dredges throughout the low-water season and to their care and repair during the high-water period of the fiscal year 1917. The estimate of \$35,000 for the fiscal year ending June 30, 1918, is to cover snagging operations.

Commercial statistics.—Plantation products made up 18 per cent, miscellaneous freights 10 per cent, and forest products 72 per cent of the commerce for the calendar year 1915. Thirty-nine per cent of the total was saw logs in rafts. The reduction in tonnage is attributed to the general depression in the lumber trades; the increase in unit value to the increase in package freight out of Pine Bluff.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	55,228	\$573,089
1914.....	79,169	812,657
1915.....	39,966	800,868

Amount expended on all projects from July 3, 1832, to June 30, 1916:

New work-----	\$1,018,511.93
Maintenance-----	2,553,532.77
Total-----	3,572,044.70

Balance available for fiscal year ending June 30, 1917-----	309,499.56
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	35,000.00

WHITE RIVER, ARK.

Location and description.—This river rises in northwestern Arkansas, flows north into Missouri and thence southeasterly through Arkansas, emptying into the Mississippi River about 87 miles below

Helena through a mouth common to both the White and Arkansas Rivers. The project includes the section from the mouth to Batesville, 301 miles. The total length is 690 miles; the drainage area is 28,000 square miles, of which 11,150 square miles lies in the Ozark Mountains above Batesville.

Existing project.—The present project is for channel maintenance between the mouth of the river and Batesville, 301 miles, by contraction works, by the removal of rocks, bowlders, and snags, and by dredging. It dates from the river and harbor act of March 3, 1899, which contemplated the construction of locks and dams for a portion of the river above Batesville, thereby reducing the scope of the open-channel improvement project to the river below that town. Since 1899 the work has been prosecuted under annual appropriations for maintenance of channel without reference to any estimate for completion or to any definite degree of improvement to be obtained, except in one instance, when the river and harbor act of March 2, 1907, authorized the construction of a revetment and levee near Augusta for the purpose of preventing a cut-off. The river and harbor act of July 27, 1916, authorized work for preventing a cut-off at Devall Bluff in accordance with House Document No. 1259, Sixty-second Congress, third session.

Direct snagging operations.....	\$12, 614. 98
Rebuilding snag boat <i>Quapaw</i> (completion).....	2, 858. 37
Total	15, 473. 35

Condition at the end of fiscal year.—During the period 1881–1894 wing dams of brush, gravel, and stone were built at eight localities between Batesville and Jacksonport. Only slight traces of these works remain, and they are of no consequence at this time. Between the period 1890–1894 eight wing dams were built at four localities between Newport and the mouth of the river, 257 miles. Seven of these are still in place, but rarely visible at dead low water. No material benefit has resulted. At three different times a dipper dredge was operated between Jacksonport and Batesville, channel depths of 3½ feet at dead low water being obtained, which lasted until the next important freshet. Snagging operations have been under way since 1871 and have materially bettered the natural condition of the channel. During the entire fiscal year the river was navigable by boats of 4 feet draft to Jacksonport. Between Jacksonport and Batesville depths of 2 feet or over existed for 11 months. The total expenditures under the existing project to June 30, 1916, were:

For snagging operations.....	\$186, 673. 94
For dredging operations.....	9, 913. 52
Augusta Narrows, levee and revetment.....	25, 800. 00
Specials:	
Augusta, for prevention of cut-off.....	314. 84
Devall Bluff, for prevention of cut-off.....	883. 36
Little Red River, snagging, 1914.....	500. 00
Total	224, 085. 66

Effect of improvement.—Snagging operations, by clearing the channels, have rendered available for navigation the full natural depths of the stream. The improvement has had no material effect upon freight rates.

Proposed operations.—The funds available for the fiscal year ending June 30, 1916, will be expended in maintenance of channel by snagging and dredging operations, the probable expenditures during the fiscal year to be about as follows:

For snagging operations.....	\$19, 500
For dredging between Jacksonport and Batesville.....	4, 000
Total	23, 500

The operations outlined above will be carried on during the low-water season, which generally ends about the latter part of December. The probable balance that will remain on hand June 30, 1917, is taken into consideration in preparing the estimate for the additional sum of \$19,200 to cover work of maintenance in the fiscal year 1918. This exceeds the average expended during the preceding three years. Because of shortage of plant, little was done in the fiscal year 1915 and a full operating season was not used in the fiscal year 1916.

Since the original estimate was submitted for work to prevent a cut-off at Devall Bluff changes in the physical conditions have occurred which make the estimate of \$14,000 entirely insufficient. The cost of the necessary work for this purpose is now estimated to be \$30,500. Changes in the commercial situation have also occurred which render this large expenditure of doubtful worthiness, as reported in House Document No. 579. Sixty-fourth Congress, first session. Accordingly no additional estimate is submitted for this work.

Commercial statistics.—Forest products comprised 77 per cent, plantation products 4 per cent, and general or miscellaneous freights 19 per cent of the commerce reported during the calendar year 1915. The reduction of commerce shown for that year arises from the general depression that existed in the lumber business and an unusually high overflow, which began in August and continued into the middle of September, overflowing the bottom lands to such an extent that logging operations were brought to a standstill for the greater part of the autumn. The American Bauxite Co. conducted a short-term experiment with the transportation of bauxite from Devall Bluff to East St. Louis. It is understood that as a result of this experiment they contemplate the construction of special appliances for handling a large tonnage of this commodity.

Comparative statement.

Calendar year.	Short tons.	Estimated value.
1913.....	264, 817	\$1, 016, 305
1914.....	253, 331	1, 060, 526
1915.....	165, 230	838, 414

Amount expended on all projects from Mar. 3, 1871, to June 30,

1916:	
New work.....	\$388, 601. 57
Maintenance.....	201, 484. 09
Total.....	590, 085. 66
Balance available for fiscal year ending June 30, 1917.....	\$34, 131. 15
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	19, 200. 00

BLACK AND CURRENT RIVERS, ARK. AND MO.

Prior to the fiscal year 1905, these works were provided for under separate appropriations. They were consolidated by the river and harbor act of March 3, 1905.

(A) BLACK RIVER.

Location and description.—This river rises in the Ozark Mountains in southeastern Missouri and flows in a southerly direction into the White River at Jacksonport, total length 300 miles. The section from Poplar Bluff, Mo., to Jacksonport, 213 miles, lies in an alluvial basin and is under improvement.

Existing project.—The present project, adopted by the river and harbor acts of June 14, 1880, and March 3, 1881, contemplates improvement of the river below Poplar Bluff, Mo., 213 miles, by snagging operations, by deepening the water on shoals by wing dams, and by concentrating the water into one main channel by the closure of secondary channels, at an estimated cost of \$80,800, to be expended in two working seasons. (Annual Report for 1880, p. 1326.) The amount appropriated by river and harbor act of September 19, 1890, completed the estimate. That act authorized the maintenance of the improvement. While dredging is not specifically mentioned in the project, it is necessary as a means of maintenance and has been so authorized.

Condition at the end of fiscal year.—A few wing dams have been built and a small amount of dredging has been done, but snagging operations constitute the principal activity. These operations have made possible all-year-round navigation to Poplar Bluff, Mo., by boats of 18 inches draft and to the mouth of Current River by boats of 30 inches draft. As a rule these minimums obtain during only two months, August and September. For the greater part of the year the load draft of the boats operated on this river is 4 feet below Current River and $2\frac{1}{2}$ feet above. The total expenditures under the existing project to the end of the fiscal year are:

For new work.....	\$80,000.00
For maintenance.....	165,547.26
Total.....	245,547.26

Effect of the improvement.—Navigation has been made easier and safer and the navigation period extended to all the year round. There is no evidence that the improvement has had any material effect upon freight rates between river points, but as to freights between river and rail points the boats operating on the lower reaches of this river and the railways in the same territory now interchange freights on through bills of lading.

Proposed operations and Commercial statistics.—See paragraphs applying to both rivers.

(B) CURRENT RIVER.

Location and description.—This river rises in the Ozark Mountains in southeastern Missouri and flows in a southerly direction into the Black River about 5 miles above Pocahontas, Ark.; total length, 200 miles. At the State line, 41.5 miles above the mouth, the river enters the alluvial basin.

Existing project.—The present project, adopted by the river and harbor act of August 18, 1894, is for the improvement of the river from Van Buren, Mo., to the mouth, 94 miles, by snagging operations and by contracting the channel at the worst shoals by wing dams, at an original cost of \$10,000. (Annual Report for 1891, p. 2065.) The appropriation of June 3, 1896, completed the estimate. The continuation of the improvement by maintenance is authorized by the river and harbor act of March 3, 1899.

Condition at the end of fiscal year.—Operations under this project have been confined solely to snagging operations and the removal of bowlders. These operations have rendered available for navigation purposes the natural depths of the stream, giving all-year-round navigation by boats of 3 feet draft to Blunts, 25 miles; 2 feet draft from Blunts to Little Black River, 7 miles; 16 inches draft from Little Black River to Missouri State line; and 10 inches draft thence through to Van Buren, Mo. The channel between Blunts and the State line is becoming filled with obstructions again because of the limited amount of work done on this river during the last two seasons. Steam and gasolene boats with a customary load draft of 3½ to 4 feet ply the lower section of the river below Little Black in connection with timber industries. Small stern-wheeled gasolene-engined boats of 8 to 10 inches draft ply the river between Doniphan and Van Buren in connection with the movement of farm products and supplies. Logs and ties are floated over the entire river. The expenditures under the existing project to the end of the fiscal year are:

For new work	\$10, 000. 00
For maintenance	54, 680. 28
Total	64, 680. 28

Effect of improvement.—In the lower reaches all-year-round navigation has been provided for the class of boats engaged upon this and Black River. Navigation has been made easier and safer throughout the other reaches. There is no effect upon railway freight rates, since the river is not a competitor with railway lines. The improvement serves to give an outlet to railroad points from localized isolated territories.

BOTH RIVERS.

Proposed operations.—The fund available for the fiscal year ending June 30, 1917, will be expended in operating two snag boats on both streams until the beginning of the high-water period, which begins about the middle of January, and in their care and repair until the next low-water season arrives. There will be an available balance at the close of the fiscal year 1917, and this has been taken into consideration in the estimate for the fiscal year 1918.

The amount estimated for the fiscal year ending June 30, 1918, is for maintenance of channel by snagging operations in both rivers and by dredging operations in Black River below the mouth of Current River. The approximate distribution of the additional funds needed for that year is as follows:

Snagging operations, 2 snag boats and 1 chopping party	\$1, 500
Dredging operations by dipper dredge, two months	4, 500
Total additional funds needed	6, 000

Commercial statistics.—Logging and kindred industries furnished the bulk of the commerce on both streams. Of those reported for the calendar year 1915, 97 per cent on Black River and 98 per cent on Current River arose from those sources. The falling off of the tonnage on Current River is attributed to two causes; one was the general depression in the hardwood lumber and the railway-tie trade, and the other to a serious overflow in August, which flooded the bottom timberlands and restricted the output from them. The same causes served to reduce the tonnage on Black River in a minor degree. Revival in business along these lines of trade, together with the establishment of interchange of freights between boats and railways, is expected to result in a considerable increase in Black River commerce during the ensuing year.

Comparative statement.

Calendar year.	Black River.		Current River.	
	Short tons.	Value.	Short tons.	Value.
1913.....	199,535	\$676,962	18,836	\$140,983
1914.....	169,679	586,674	21,512	103,084
1915.....	128,262	467,199	6,371	31,855

Consolidated.

Amount expended on all projects from Mar. 3, 1871, to June 30, 1916:

New work.....	\$97,000.00
Maintenance.....	220,227.54
Total.....	317,227.54

Balance available for fiscal year ending June 30, 1917.....	35,119.58
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	6,000.00

ST. FRANCIS AND L'ANGUILLE RIVERS AND BLACKFISH BAYOU, ARK.

(A) ST. FRANCIS RIVER, ARK.

Location and description.—This river rises in the Ozark Mountains in southeastern Missouri and flows in a southerly direction to the Mississippi River, 8 miles above Helena; total length, 460 miles. In its physical characteristics it is divisible into four main sections: First, the hill section, 120 miles long, above Wappapello, Mo.; second, a flat-land section, 84 miles long, between Wappapello and St. Francis town; third, through the so-called Sunken Lands, 107 miles, between St. Francis town and Marked Tree, Ark.; and, fourth, below Marked Tree, 149 miles.

(B) L'ANGUILLE RIVER.

Location and description.—The L'Anguille River has its source in the flat lands of Poinsett and Craighead Counties, Ark., whence it flows in a southerly direction into the St. Francis, 12 miles above

the mouth of the latter. The present project includes the section of the river from its mouth to Marianna, 8 miles.

ST. FRANCIS AND L'ANGUILLE RIVERS, ARK.

Existing project.—The existing project is considered to date from the river and harbor act of June 13, 1902, which added the improvement of the L'Anguille River to the project for the St. Francis River. The project provides for the closure of sloughs and chutes in the Sunken Lands of the St. Francis River and for snagging operations on the St. Francis from its mouth to Kennett, Mo., and on the L'Anguille from its mouth to Marianna. The project contemplates making the St. Francis navigable at high stages to Kennett, Mo.; at medium stages to Marked Tree, Ark.; at low stages, to a point about 30 miles below Madison, Ark.; and for clearing the L'Anguille of such obstructions as interfere with navigation during periods when there is sufficient backwater for navigation purposes.

Condition at the end of fiscal year.—Snagging operations has been the only work done under either the previous or the existing project. In the earlier operations on St. Francis River a limited amount of such work was done above Marked Tree. Of late years all operations have been confined to the river below that town. The river is in fine condition for navigation by boats of 4 feet draft when at medium or high stages. Two feet draft is the limit during ordinary low stage, and during lowest waters, which continue on an average for about three weeks in the autumn, 12 to 14 inches is the limiting draft for a boat 18 or 20 feet wide. The navigation periods for boats of 5 to 7 feet draft are controlled below Madison in the main by the backwater stages of the Mississippi River. The total expenditures under the existing project to June 30, 1916, are \$71,531.91, all for maintenance.

Effect of improvement.—The improvement has had no material effect upon freight rates, except on freights moving between Marianna and Mississippi River points. On such the river rate is slightly less than the rail rate. The principal benefit derived from the improvement has been the lengthening of the navigation periods.

Proposed operations.—See paragraph under "Blackfish Bayou."

(C) BLACKFISH BAYOU.

Location and description.—This stream rises in the west central portion of Crittenden County, Ark., flows in a southwesterly direction, and empties into the St. Francis River about 38 miles above the latter's mouth. Its drainage basin—all flat alluvial land—has an area of about 510 square miles. From St. Francis River up to the mouth of Fifteenmile Bayou—6 miles—the Blackfish Bayou is 250 to 300 feet wide between banks, with low-water widths of 125 to 150 feet, and with controlling low-water depths of about 2 feet for the first half of the distance and 8 to 10 inches for the last half; this is the section covered by the project. Above the mouth of Fifteenmile Bayou it is narrow, crooked, and shallow. Its medium and high stages are dependent upon the backwater effects of St. Francis and Mississippi Rivers.

Existing project.—The existing project adopted by the river and harbor act of June 25, 1910, in accordance with report printed in House Document No. 73, Sixty-first Congress, first session, provides for the removal of snags and overhanging timber obstructing the channel in connection with similar work on the St. Francis River, at an estimated cost of \$500 annually. The said act provides that of the consolidated appropriation made not exceeding the sum named may be expended, in the discretion of the Secretary of War, for the purpose stated.

Condition at the end of the fiscal year.—The channel is in excellent condition for navigation during medium and high stages, and the full natural depths have been rendered available for navigation at all stages. For an average of three months in each spring Mississippi River boats of 6 to 7 foot draft operate here in the movement of forest products to Mississippi River points. The total expenditures under the existing project of June 30, 1916, were \$2,500.

Effect of improvement.—This stream is a feeder to the commerce of the St. Francis, and its improvement has no effect upon freight rates, either rail or water. The commercial benefit derived is through the lengthening of the navigation periods by reason of the clearing of obstructions from the channel.

ST. FRANCIS AND L'ANGUILLE RIVERS AND BLACKFISH BAYOU, ARK.

Proposed operations.—Approximately \$6,500 of the funds available for the fiscal year ending June 30, 1917, will be expended during the low-water season of the year in snagging operations in St. Francis River below Marked Tree, in Blackfish Bayou below the mouth of Fifteenmile, and in L'Anguille River below Marianna. The balance that will remain available at the close of the fiscal year is taken into consideration in making the estimate for the fiscal year ending June 30, 1918.

The estimated additional amount needed for the fiscal year ending June 30, 1918, is \$3,500, of which \$3,000 is to be expended in snagging operations in St. Francis and L'Anguille Rivers and \$500 in Blackfish Bayou.

Commercial statistics.—There is no separation of the commerce carried over the three rivers. That arising or terminating on Blackfish Bayou passes over portions of the St. Francis River, as does most of that terminating on L'Anguille River. Whenever the L'Anguille River is navigable to Marianna regular packet-boat service is maintained to that town as part of like service on the St. Francis River below Blackfish Bayou. On other portions of the river the general commercial freights are handled by small gasoline boats, irregularly operated. The movement of forest products, either in barge or in raft, constitutes the bulk of the commerce. Such products made up 98½ per cent of the total tonnage reported for the calendar year 1915. Ninety-two per cent of the forest products were saw logs in raft. The cause of the falling off of commerce during the calendar year 1915 is attributed largely to general depression in the lumber trades and to continued overflow conditions; however, the completion of a railway through the lower St. Francis Basin probably had some effect in this reduction.

Comparative statement.

Calendar year.	Short tons.	Estimated value.
1913.....	346,557	\$1,232,178
1914.....	296,354	753,680
1915.....	146,442	462,500

CONSOLIDATED.

Amount expended on all projects from Mar. 3, 1871. to June 30, 1916:	
New work.....	\$92,000.34
Maintenance.....	74,031.91
Total.....	166,032.25
Balance available for fiscal year ending June 30, 1917.....	12,614.45
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	3,500.00

CUMBERLAND RIVER, TENN. AND KY.

(A) ABOVE NASHVILLE.

Location and description.—The Cumberland River is formed by the junction of Poor and Clover Forks in Harlan County, Ky., about 687 miles above its mouth, and flows west to Burnside, Ky., from whence it makes a loop into Tennessee, passes Nashville, and returns to Kentucky, emptying into the Ohio near Smithland, Ky. The project provides for the improvement of the 326.1 miles of the river between Burnside and Nashville and of the 192.6 miles below Nashville.

Condition at the end of fiscal year.—The work done under previous projects of open-channel work resulted in increased depths and improved conditions at the principal obstructions. The modified project of canalization providing for the construction of eight locks and dams has been completed. These locks and dams provide at extreme low water a navigable channel 6 feet deep from Lock 1 (2.6 miles below Nashville) to West Point (125.2 miles above Nashville); 6 feet deep from Lock 21 to Waitsboro Shoals (25 miles); and 4 feet deep from Waitsboro Shoals to Burnside (4 miles). The expenditures for maintenance have kept the channel from Nashville to Burnside fairly free from snags and surface obstructions. The depth at extreme low water over the shoalest part of the reach between West Point and Lock 21 (70 miles in Tennessee and 101.9 miles in Kentucky) is about 0.5 foot. In this section, 12-inch navigation is frequently possible throughout the year. Sixteen-inch navigation is practically certain from December 15 to June 15, and usually possible from December 1 to August 1. Three-foot navigation is practically certain from February 1 to May 1, and usually possible from January 1 to June 1. Four-foot navigation is usually possible from February 1 to May 1, but no period can be fixed during which it is reasonably certain. Navigation for vessels drawing over 4 feet is uncertain at all times. When the Celina gauge reads 1 foot, 16-inch navigation is practicable,

and for each additional foot of reading on this gauge the navigable depth is increased 0.8 foot. The total amount expended under the present project was \$2,855,583.23 for new work, including payments for claims, and \$68,266.55 for maintenance, a total of \$2,923,849.78.

Local cooperation.—The river and harbor act of June 25, 1910, made appropriation for the completion of Lock and Dam No. 21, on condition that local interests provide a suitable landing place convenient to the city of Burnside, which should forever be open to the public on just and equal terms. Local interests complied with this condition by purchasing and conveying to the city of Burnside a proper landing place, to be used in accordance with the terms of the act.

Effect of the improvement.—The completion of Lock No. 21 has caused a reduction in freight rates of about one-half within its pool area. Locks Nos. 1 to 7 have caused a reduction in railroad freight rates between Nashville and Carthage, 115.8 miles, and in river freight rates between Nashville and West Point, 125.2 miles. For detailed statement see Annual Report for 1913, pages 2480–2481. Between West Point and Lock No. 21 the navigable season was lengthened by work under the previous project, and the channel has been kept in fairly good condition for navigation at times when the stage is sufficient for the passage of river craft.

Proposed operations.—The funds available for the fiscal year 1917 will be expended in the maintenance of the channel by the removal of snags and similar obstructions. It is proposed to do this work in a period of four months with the snag boat and attendant plant, the operation and repair of which is estimated at \$5,000. The balance of the funds available will be held for the payment of incidental expenses. With the funds to be appropriated for the fiscal year 1918 it is proposed to remove the newly accumulated snags, etc., at an estimated cost of \$5,000, the expenditure to be made in the same manner as proposed for the fiscal year 1917.

Commercial statistics.—About one-half of the total tonnage above Nashville uses the improved sections. The total commerce above Nashville for the calendar year 1915 amounted to 266,639 short tons, valued at \$4,317,061. Of the total tonnage, 14 per cent was rafted forest products, 22 per cent boated forest products, 7 per cent farm products, 7 per cent manufactured articles, 49 per cent sand and gravel, and 1 per cent coal, shells, and miscellaneous. The following table gives a comparative statement of the total commerce for the calendar years indicated:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	337,824	\$7,250,766
1914.....	314,028	6,784,999
1915.....	266,639	4,317,061

Omitting sand and gravel and rafted timber products the traffic for 1913 was 120,559 short tons; for 1914, 116,110 short tons; and for 1915, 96,355 short tons.

Amount expended on all projects from Aug. 14, 1876, to June 30,

1916:

New work -----	\$3, 221, 836. 17
Maintenance -----	68, 266. 55

Total -----	3, 290, 102. 72
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Balance available for fiscal year ending June 30, 1917 -----	9, 110. 65
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement -----	5, 000. 00
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CUMBERLAND RIVER ABOVE NASHVILLE, TENN.—NEW PROJECT.

Abstract from the report of the Board of Engineers (in which the Chief of Engineers concurs), printed in Rivers and Harbors Committee Document 10, Sixty-third Congress, second session:

The distance covered by the survey from Locks Nos. 7 to 21 is about 171 miles, the fall being 127.5 feet. The original slack-water project for this reach provided for the construction of 13 locks and dams, while the present survey indicates that the number may be reduced to 10 without undue flooding of the banks. The estimated cost of the improvement is in round numbers \$4,500,000 for first construction and \$50,000 per year for operation.

It appeared from information furnished by parties in interest that the commercial statistics heretofore reported for this section of river were incomplete and more or less unreliable. This led to a more thorough investigation of the subject, in which the district officer was assisted by the Cumberland River Improvement Association. Data now available indicate that there is a commerce on the upper Cumberland amounting to about 300,000 tons, which is considerably more than heretofore reported.

The district officer goes into considerable detail regarding the difficulties and hardships experienced by the people living adjacent to this section of river, due to the entire lack of rail transportation, the uncertain and intermittent facilities afforded by the river, and the large annual flood losses of timber and farm products stored on the banks awaiting a favorable stage for shipment. He also outlines the advantages and benefits that would result from better water transportation. He is of opinion that the extent of the present traffic and the likelihood of a considerable increase following the completion of the slack-water system justify the construction of the additional 10 locks and dams required, provided, however, that the States of Kentucky and Tennessee shall bind themselves to pay all damages arising from flowage, as well as the cost of ascertaining the same.

The division engineer does not think that the work is justified by the commercial benefits to the general public, but he states that the present inquiry discloses important benefits to the locality that indicate the propriety of requiring local cooperation such as is often obtained from a community where it is furnished an effective transportation line. He is of opinion that the additional work should not be undertaken except on the condition that the States of Kentucky and Tennessee, or the local communities affected, shall contribute one-half of the estimated cost of construction. Otherwise he concurs with the district officer.

In addition to the information contained in the reports of the district officer and in those heretofore submitted, the board has given consideration to statements and arguments made at a hearing given at its office on January 28, 1914, which was attended by Hon. Ollie M. James, United States Senator; Hon. John K. Shields, United States Senator; Hon. Cordell Hull, Hon. Swagar Sherley, Hon. Harvey Helm, Hon. A. O. Stanley, Hon. A. W. Barkley, Hon. J. W. Byrns, Hon. J. A. Moon, and Hon. Caleb Powers, Members of Congress; Mr. W. E. Myer, and Mr. B. L. Quarles, all of whom addressed the board. Attention is invited to the record of the hearing forwarded herewith.

The section of country tributary to the Cumberland River between Locks 7 and 21, covering a very large area, is practically without any economical transportation facilities, and it appears from statements made at the hearing that there is no prospect of any railroad entering this section, not, however, on account of any lack of freight. A large part of this area is covered with timber of high value within hauling distance of the river, but under the existing uncer-

tainties of navigation it can not be economically marketed. Much of the land in the valley and back in the hills is fertile but can not be cultivated to advantage for the same reason. There are also extensive coal lands that can be made tributary to the upper reaches of the river by short-rail connections, and it is claimed that these lands will be developed and that coal will be shipped out in large quantities. Much stress has been laid upon the fact that the United States has undertaken the improvement of both the upper and lower Cumberland by locks and dams, where the country has the benefit of rail transportation, leaving unimproved the section now under consideration, which is without rail facilities or the prospect of having any.

The amount of commerce at present is not extensive when considered in connection with an expensive slackwater improvement, and the amount that may be expected in the future is only conjectural, and it is believed that, measured by the usual standards applied in considering the question of advisability in such cases, it would hardly be sufficient to warrant a favorable recommendation. It is believed, however, that the present case is exceptional by reason of the vast territory affected, with no means of transportation, present or prospective, except by the river, and particularly because of the fact that Congress has undertaken the improvement of the river both above and below, leaving unimproved this section, the commerce of which must be largely looked to for justification of work already undertaken.

In view of the circumstances, the board concurs with the district officer and reports that in its opinion it is advisable for the United States to undertake the improvement of the Cumberland River from Lock 7 to Lock 21, as proposed by the district officer, at an estimated cost of \$4,500,000 for construction, and about \$50,000 annually for maintenance, provided, however, that the States, counties, or other local agencies shall bind themselves to protect the United States against any and all claims for damages due to overflow. The project should be subject to such minor modification from time to time by the Chief of Engineers as experience with the work indicates to be advisable. The first appropriation should be \$340,000 for securing all lock and dam sites and for beginning construction of Lock and Dam No. 8.

(B) BELOW NASHVILLE.

Location and description.—See this heading under “(A) Above Nashville.”

Existing project.—The present project, or project of canalization of the Cumberland River below Nashville, may be considered to have been adopted by the river and harbor act of July 13, 1892, based on report of survey dated December 21, 1889. (Annual Report for 1890, p. 2151.) Under this project seven locks and dams were at first provided for (Locks A to G), and Lock A, the first of the series, was placed in operation in November, 1904. A modification of this project was adopted by the river and harbor act of June 25, 1910, based on reports of a survey of the lower Cumberland. (H. Doc. No. 758, 60th Cong., 1st sess., and H. Doc. No. 1481, 60th Cong., 2d sess.) This modification contemplates the completion of the canalization by the construction of five additional locks, beginning with Lock B, 51.5 miles below Nashville, and ending with Lock F, the revised location of which is 149 miles below Nashville, thus reducing the total number of locks from 7 to 6. It also includes dredging the rest of the river to the mouth (43.6 miles) to obtain a channel 150 feet wide and 6 feet deep at low water. The amount expended for improvement work under the present project to June 30, 1910, was \$419,848.01, representing the expenditure prior to the modification of the project, which modification included an estimated cost for completing the improvement of \$3,164,882.40. The total estimated cost for completing the present project is, therefore, \$3,584,730.41.

and the estimated annual cost for operation and maintenance is \$40,000. (For map see H. Doc. No. 1481, 60th Cong., 2d sess., p. 8.)

Condition at the end of fiscal year.—The work done under previous projects of open-channel work resulted in increased depths and improved conditions at some of the worst shoals and in the protection of a part of the bank of Cumberland Island, at the mouth of the river. Under the existing project Lock A was completed November 24, 1904, at a cost of \$390,600. The degree of completion of Locks B, C, and D was 85 per cent, 60 per cent, and 77 per cent, respectively, at the end of the fiscal year. The construction of the remaining locks and dams, E and F, and the proposed dredging between Lock F and the mouth were not commenced. The snagging operations have kept the channel fairly free of snags and surface obstructions. The existing project as a whole was 45 per cent completed at the end of the fiscal year. Lock A provides 6-foot navigation at extreme low water for 38.8 miles up to Lock 1, the first lock constructed under the project above Nashville. The depth at extreme low water over the shoalest part of the reach between Lock A and the mouth (151.2 miles) is about 0.5 foot. In the section between the mouth and Lock A navigation for craft drawing up to 16 inches is usually possible throughout the year and is practically certain from December 1 to September 10. Three-foot navigation is practically certain from December 20 to June 15 and usually possible from December 1 to July 20. Five-foot navigation is practically certain from January 15 to May 15 and is usually possible from December 15 to June 1. Six-foot navigation is usually possible from January 1 to May 15, but no period can be fixed during which it is practically certain. Sixteen-inch navigation is possible when the Clarksville gauge reads about 0.5 foot. When the Clarksville gauge reads 1 foot, 16-inch navigation is practicable, and for each additional foot of reading on this gauge the navigable depth is increased 0.8 foot. The total amount expended under the present project, exclusive of outstanding liabilities, was \$1,632,172.57 for new work and \$45,292.73 for maintenance, a total of \$1,677,465.30.

Effect of improvement.—The improvement effected under the former projects undoubtedly facilitated navigation by the removal of snags and other obstructions, as well as by the giving of somewhat greater low-water depth over the shoal places. The construction of Lock and Dam A submerged the shoal, which prior to that formed the most serious obstruction to low-water navigation, and gave for the 38.8 miles below Lock No. 1 of the upper river improvement a navigable depth of at least 6 feet throughout the year. The work on Locks B, C, and D will not facilitate navigation until the locks and dams are completed and placed in operation; nor can it be expected that the lower Cumberland River will be continuously navigable until the two remaining locks and dams have been completed. Nevertheless, even in its present condition, the lower Cumberland River has a marked effect on railroad freight rates, and the navigable facilities offered by this stream are undoubtedly responsible for the favorable freight rates which Nashville has been granted, as compared with rates between towns not connected by a navigable waterway. The effect of the continuous navigation provided by the canalization for the 41.4 miles below Nashville was noted for the immediate reduction by about 50 per cent in the rates charged by the Tennessee

Central Railroad over that part of its line which parallels the pool of Dam A.

Proposed operations.—With the funds available for the fiscal year 1917 it is proposed to continue the work at Locks B, C and D and to let contracts for the construction of Locks E and F, including all concrete and bank-protection work on the lock side at each lock. It is expected that practically all work at Locks B, C, and D will be completed during the year, and while the contract work at Locks E and F will probably not be completed, it will not be economical to let contracts for a less amount of work than that proposed. The whole of the funds available will therefore be either expended or pledged during the year. The following estimate is submitted:

1. Completion of bank protection and the dams at Locks B and C, providing principally for labor in connection therewith-----	\$163, 000. 00
2. Six lock houses at Locks B, C, and D, at \$3,500 each-----	21, 000. 00
3. Construction of Lock E-----	239, 000. 00
4. Construction of Lock F-----	295, 000. 00
5. Engineering and contingencies-----	70, 916. 04
6. Maintenance of channel by open-river work-----	5, 000. 00
Total -----	793, 916. 04

With the funds to be appropriated for the fiscal year 1918 it is proposed to complete all work for Locks B to F, inclusive, and to provide for an excess over the estimates of the contract work for these locks, in accordance with the following estimate:

Abutment and bank protection at Lock E-----	\$71, 000
Abutment and bank protection at Lock F-----	76, 000
Completion of the lockmen's houses and the improvement of the grounds, Locks B to F, inclusive-----	74, 000
Dam at Lock E-----	75, 000
Dam at Lock F-----	75, 000
Steel gates and miscellaneous ironwork-----	40, 000
Additional contract quantities, etc., Locks B, C, and D-----	80, 000
Increased quantities estimated for Locks E and F over last estimate---	36, 000
Engineering and contingencies-----	105, 000
Total -----	632, 000

The proposed improvements are necessary in order to provide sufficient depth in the river below Lock D for navigation throughout the year by the principal boats operating in this section of the river.

Commercial statistics.—About 35 per cent of the total tonnage below Nashville uses the improved section. The total commerce below Nashville for the calendar year 1915 amounted to 126,949 short tons, valued at \$2,172,058. Of the total tonnage, 2 per cent was rafted forest products, 73 per cent boated forest products, 8 per cent farm products, 4 per cent manufactured articles, 12 per cent sand and gravel, and 1 per cent miscellaneous articles. The following table gives a comparative statement of the total commerce below Nashville for the calendar years indicated:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	165, 123	\$2, 705, 431
1914.....	153, 458	2, 238, 207
1915.....	126, 949	2, 172, 058

Omitting sand and gravel and rafted timber products the traffic for 1913 was 152,978 short tons; for 1914, 111,745 short tons; and for 1915, 109,079 short tons.

Amount expended on all projects from July 17, 1832, to June 30, 1916:

New work-----	\$2, 092, 172. 57
Maintenance -----	45, 292. 73
Total -----	<u>2, 137, 465. 30</u>
Balance available for fiscal year ending June 30, 1917-----	793, 916. 04
Amount (estimated) required to be appropriated for completion of existing project-----	910, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement-----	632, 000. 00

TENNESSEE RIVER ABOVE CHATTANOOGA.

Location and description.—The Tennessee River is formed by the junction of the French Broad and Holston Rivers in eastern Tennessee, $4\frac{1}{2}$ miles above Knoxville, flows southwest into northern Alabama, thence in a generally west course across north Alabama, and from the northeast boundary of Mississippi nearly due north across Tennessee and Kentucky, entering the Ohio River at Paducah, 652 miles from the junction of the French Broad and Holston Rivers.

The two important shoal sections designated as the Muscle Shoals and the Colbert Shoals (each of which is subdivided by local designation) have steep slopes, with swift currents and shallow depths. The slope in places is as much as 15 feet to the mile; there are currents in excess of 10 miles per hour; and the minimum available low-water depth in places is only 6 inches. Before the construction of the Hales Bar Dam the 33 miles of the river below Chattanooga, known as the mountain section, also contained serious obstructions caused by the excessive slopes and currents and the small depths found at the shoals. The remainder of the river consists, as usual with rivers of the Mississippi Valley, of a series of pools separated by shoals, which on the Tennessee are usually of rock and ordinarily covered by a deposit of gravel or sand. Below Big Bend Shoals, 23 miles below Riverton, there are no rock bars sufficiently near the surface to be obstructive to navigation, the obstructions on that section consisting entirely of sand and gravel bars.

Existing project.—The existing project was adopted by the river and harbor act of July 25, 1912, in accordance with report printed in House Document No. 360, Sixty-second Congress, second session, the adopted project being that recommended on the second page thereof. It provides for improving 24.6 miles of the river by the construction of a concrete lock and dam at the foot of Caney Creek Shoals (including cost of flowage rights), suitable for 6-foot navigation, and for securing throughout the remainder of the 188 miles of the section, by rock excavation, by dredging, and by contraction works, a channel 150 feet wide and 3 feet deep at extreme low water. The estimated cost is \$2,225,614.57 (first estimated at \$1,600,000) for the lock and dam, including flowage rights, and \$1,636,466.78 (first estimated at \$1,057,081.35) for open channel work, a total of \$3,862,081.35, and \$25,000 annually for maintenance. (For map

see Annual Report for 1913, p. 2492.) The following data relative to the proposed lock and dam is given:

Name of lock: Caney Creek.

Location: 8 miles below Kingston, Tenn., and 95.8 miles above Chattanooga, Tenn., 559.8 miles above the mouth of the river.

Length of lock between miter sills: 300 feet.

Width: 60 feet.

Depth on miter sills at extreme low water: 6.5 feet.

Lift of dam above extreme low water: 25.7 feet.

Character of foundation: Rock.

Kind of dam: Fixed.

Type of construction: Concrete.

Estimated cost: \$2,225,614.57.

Condition at the end of the fiscal year.—Surveys and borings had been made and a suitable site found for the Caney Creek Lock and Dam, but the necessary lands had not been purchased and no construction work had been done. The open channel work was about 50 per cent completed. Although some of the most obstructive shoals have been improved and light-draft traffic has been made possible over the entire section, except at periods of extreme low water, it will not be practicable to have through traffic between Knoxville and Chattanooga throughout the year until the entire project is completed. The minimum available depth in the section above Chattanooga was about one-half foot at extreme low water, but the river is usually navigable for 1-foot draft throughout the year, for 2-foot draft from December 15 to September 15, and for 3-foot draft from January 1 to July 1. Draft of 4 feet and over is occasionally practicable for short disconnected periods during the high-water months of January to April, inclusive. When the Knoxville and Loudon gauges read 0 and —0.5, respectively, 1-foot navigation is practicable; and for each additional foot of reading on these gauges 1 additional foot of navigable depth is practicable. The total amount expended under the present project, exclusive of outstanding liabilities, was \$25,614.57 for the Caney Creek Lock and \$798,537.04 for open channel work, a total of \$824,151.61, all of which was for new work.

Effect of the improvement.—Navigation has been facilitated by the improvement of some of the worst localities, but the controlling depth over the entire section has not been increased. Until traffic between Knoxville and Chattanooga has been made possible throughout the year no material effect on commerce is expected.

Proposed operations.—With the funds available for the fiscal year 1917 it is proposed to complete the improvements at Williams, Lyons, Sale Creek, Washington-Hazleridge, and Coulter Island Shoals, and to begin the improvements at Loudon, North Chickamauga, and Chota Shoals. The following estimate is submitted:

Operation and repair of dredge <i>Tellico</i> , and attendant plant, 12 months, at \$6,500 per month	\$78,000
Operation and repair of dredge <i>Nolichucky</i> , and attendant plant, 12 months, at \$6,500 per month	78,000
Operation and repair of dredge <i>Kwasind</i> , and attendant plant, 12 months, at \$6,500 per month	78,000
Reconstruction of floating plant	25,000
Engineering and contingencies	48,000
Total	307,000

With the funds to be appropriated for the fiscal year 1918 it is proposed to complete the improvements at Loudon, North Chickamauga, and Chota Shoals, and to begin the open-channel work at Sister Island, Half Moon Island, and Cox Island Shoals. The controlling low-water depth on these shoals is only 1½ feet, and this prevents navigation throughout the year by the principal boats operating in this section. The following estimate is submitted:

Operation and repair of dredge <i>Tellico</i> , and attendant plant, 12 months, at \$6,500 per month-----	\$78,000
Operation and repair of dredge <i>Nolichucky</i> , and attendant plant, 12 months, at \$6,500 per month-----	78,000
Operation and repair of dredge <i>Kwasind</i> , and attendant plant, 12 months, at \$6,500 per month-----	78,000
Reconstruction of floating plant-----	36,000
Engineering and contingencies-----	55,000
Total-----	325,000

Commercial statistics.—The total commerce above Chattanooga for the calendar year 1915 amounted to 402,622 short tons, valued at \$3,403,995. Of the total tonnage, 6 per cent was rafted forest products, 5 per cent boated forest products, 8 per cent other farm products, 56 per cent sand and gravel, 4 per cent marble, 18 per cent iron ore, 2 per cent merchandise, including flour and meal, and 1 per cent miscellaneous, including live stock, coal, steel, cement, machinery, etc. The following table gives a comparative statement of the total commerce above Chattanooga for the calendar years indicated:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	469,685	\$2,707,363
1914.....	305,616	2,356,992
1915.....	402,622	3,403,995

Omitting sand and gravel and rafted timber products, the traffic for 1913 was 211,000 short tons; for 1914, 134,400 short tons; and for 1915, 152,992 short tons.

Amount expended on all projects from Aug. 30, 1852, to June 30, 1916:

New work-----	\$1,572,563.52
Maintenance-----	61,437.11
Total-----	1,634,000.63
Balance available for fiscal year ending June 30, 1917-----	307,183.49
Amount (estimated) required to be appropriated for completion of existing project-----	2,726,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement and for maintenance-----	325,000.00

TENNESSEE RIVER—CHATTANOOGA TO RIVERTON.

HALES BAR TO BROWNS ISLAND.

Location and description.—See this heading under “1. Tennessee River above Chattanooga.”

Existing project.—The existing project was adopted by the river and harbor acts of July 25, 1912, and July 27, 1916. It is based on

report dated December 28, 1911 (H. Doc. No. 360, 62d Cong., 2d sess.), as modified by report dated July 27, 1916 (R. and H. Com. Doc. No. 1, 64th Cong., 1st sess.). It provides for the construction of concrete locks with low dams at Widows Bar and Bellefonte Island, or for the construction of a concrete lock with high dam at Bellefonte Island, provided local interests contribute the cost of all claims for flowage damages arising from either type of dam, the Secretary of War being authorized ultimately to determine the type of dams to be constructed. Six-foot navigation at extreme low water is to be provided by the two low dams or the one high dam from Bellefonte Island to the Hales Bar Lock. The project also provides for open-channel work by dredging and by contraction works to obtain a channel 150 feet wide and 5 feet deep at extreme low water through all shoals in the 138 miles in the section between the head of Browns Island (293 miles above the mouth) and Hales Bar, except those in the reach to be canalized. The estimated cost of the locks with low dams, exclusive of flowage damages amounting to \$22,000, is \$1,345,000, in addition to the amount of \$88,000 made available prior to the date of the modified report, and \$40,000 required for additional excavation in the upper reach of the Widows Bar pool, or a total of \$1,473,000. The estimated cost of the open-channel work below Bellefonte Island is \$2,618,000, making the total project estimate \$4,091,000. In case of the construction of the lock with high dam, the estimated cost will be reduced \$160,000. For map see Annual Report for 1913, page 2498.

The following data is submitted relative to the proposed locks and dams:

	Name of lock.		
	Widows Bar.	Bellefonte (low dam).	Bellefonte (high dam).
Above mouth.....	408 miles....	392 miles....	392 miles.
Below Chattanooga.....	56.1 miles....	72.1 miles....	72.1 miles.
Length of lock between miter sills.....	300 feet.....	300 feet.....	300 feet.
Clear width of lock.....	60 feet.....	60 feet.....	60 feet.
Depth on miter sills at extreme low water.....	6.5 feet.....	6.5 feet.....	6.5 feet.
Lift of dam at extreme low water.....	8.2 feet.....	9.7 feet.....	17.9 feet.
Character of foundation.....	Rock.....	Rock.....	Rock.
Kind of dam.....	Fixed.....	Fixed.....	Fixed.
Type of construction.....	Concrete.....	Concrete.....	Concrete.
Estimated cost.....	\$779,000.....	\$694,000.....	\$1,313,000.

Condition at the end of fiscal year.—At the end of the fiscal year only preliminary work had been done, preparatory to beginning the execution of the project. Work under previous projects had improved low-water conditions so as to make light-draft traffic practicable, except at low water. The minimum available depth in the reach between Hales Bar and Browns Island was about 0.8 foot at extreme low water, but the river is usually navigable for 15-inch draft throughout the year, for 2-foot draft from December 15 to September 1, for 3-foot draft from January 1 to July 1, for 4-foot draft from January 1 to May 15. Drafts of 5 and 6 feet are occasionally practicable for disconnected periods of different lengths during the high-water months of January to April, inclusive. When the Bridgeport and Decatur gauges read 1 and 0.5, respectively, 2-foot naviga-

tion is practicable, and for each additional foot of reading on these gauges one additional foot of navigable depth is practicable. The total amount expended under the present project, exclusive of outstanding liabilities, was \$68,217.25, all of which was for new work.

Local cooperation.—The project was adopted by Congress on condition that local interests contribute the cost of all claims for flowage damages arising from the lock and dam construction. This condition has not been complied with, but it is expected to begin negotiations at once, with a view of securing compliance.

Effect of improvement.—Navigable conditions were improved by work under previous projects, but on account of the small low-water depth still prevailing the effect on commerce has been small.

Proposed operations.—Negotiations will be entered into with the view of inducing local interests to contribute the cost of all claims for flowage damage arising from the construction of low dams. In the event of this cooperation being secured it is proposed to purchase the necessary lands and to construct the Widows Bar Lock and abutment. The following estimate is submitted:

Purchase of lands and construction of Widows Bar Lock.....	\$364,000
Construction of Widows Bar abutment.....	90, 000
Excavation in upper reach of Widows Bar pool.....	66, 000
Total.....	520, 000

Since the construction of the Hales Bar Dam all of the trees along the edges of the pool above the dam between the old and new timber lines have been killed as a result of raising the water surface. Many of these trees have been broken off by wind and waves, leaving stumps that become very dangerous to navigation at certain stages and causing complaints by navigation interests. In the fiscal year 1918 it is proposed to remove all trees and stumps standing along the edges of the pool below the present timber line, at an estimated cost of \$50,000. As this work can not be paid for out of funds provided by the permanent indefinite appropriation for operating and care, it is recommended that Congress appropriate \$50,000 for this work.

Commercial statistics.—The commerce between Chattanooga and Florence for the calendar year 1915 amounted to 171,328 short tons, valued at \$9,311,081. Of the total tonnage, 2 per cent was rafted timber products, 16 per cent boated timber products, 5 per cent grain, 5 per cent cotton and cotton seed, 5 per cent other farm products, 6 per cent fertilizer, 6 per cent merchandise, 15 per cent sand and gravel, 28 per cent miscellaneous, including flour and machinery, and 12 per cent oil, cement, brick, and coal. The following table gives a comparative statement of commerce for the calendar years indicated:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	192, 881	\$13, 865, 924
1914.....	207, 232	12, 334, 623
1915.....	171, 328	9, 311, 081

Omitting sand and gravel and rafted timber products, the traffic for 1913 was 161,300 short tons; for 1914, 151,100 short tons; and for 1915, 142,540 short tons.

Amount expended on all projects from July 25, 1868, to June 30, 1916:

New work	\$1, 049, 669. 75
Maintenance	19, 671. 41
Total	<u>1, 069, 341. 16</u>
Balance available for fiscal year ending June 30, 1917.....	520, 113. 88
Amount (estimated) required to be appropriated for completion of existing project.....	3, 503, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement.....	50, 000. 00

(D) FLORENCE TO COLBERT SHOALS.

Location and description.—See this heading under “1. Tennessee River above Chattanooga.”

Existing project.—The existing project was adopted by the river and harbor act of July 25, 1912, in accordance with report printed in House Document No. 360, Sixty-second Congress, second session, the adopted project being that recommended on the second page thereof. The project provides for securing, by dredging and contraction works, a channel 150 feet wide and 6 feet deep at ordinary low water, or 5 feet deep at extreme low water, through all the shoals in the 21.3 miles of this subdivision, at an estimated cost of \$889,068.17 for original work (first estimated at \$699,068.17), and \$25,000 annually for maintenance. The foot of the project section is 235.1 miles above the mouth of the river. (For map see Annual Report for 1913, p. 2498.)

Condition at the end of fiscal year.—The project was about 90 per cent completed. The available extreme low-water depth had been increased from 1 foot to 3 feet. The total amount expended under the existing project, exclusive of outstanding liabilities, was \$816,624.11, all of which was for new work. The navigable condition in this section is about the same as that described under “3. Tennessee River below Riverton.”

Effect of improvement.—The increased depth has lengthened the navigable season for 6-foot draft by about three months. The benefit to navigation has been recent and no effect on commerce has been observed.

Proposed operations.—With the funds available for the fiscal year 1917 it is proposed to complete the open-channel work at all of the shoals now under improvement, thus completing the project before the end of the calendar year 1916. The following estimate is submitted:

Operation and repair of dredge <i>Tennessee</i> and attendant plant, 4 months..	\$45, 000
Operation and repair of dredge <i>Tuscumbia</i> and attendant plant, 4 months..	45, 000
Engineering and contingencies.....	10, 000
Total	<u>100, 000</u>

The available funds will provide for necessary work of maintenance in the fiscal year 1918.

Commercial statistics.—Commercial statistics are not collected separately for this section. For commerce in the entire section below Florence, see under “3. Tennessee River below Riverton.”

Amount expended on all projects from July 25, 1912, to June 30, 1916:

New work	\$816,624.11
Maintenance	
Amount appropriated by river and harbor act approved July 27, 1916	120,000.00
Balance available for fiscal year ending June 30, 1917	161,761.76

3. TENNESSEE RIVER BELOW RIVERTON.

Location and description.—See this heading under “1. Tennessee River above Chattanooga.”

Existing project.—The existing project was adopted by the river and harbor act of July 25, 1912, in accordance with report printed in House Document No. 360, Sixty-second Congress, second session, the adopted project being that recommended on the second page thereof. It provides for open-channel work by rock excavation and dredging and by contraction works to obtain a channel 150 feet wide and 6 feet deep at ordinary low water, or 5 feet at extreme low water, through all the shoals in the 226.5 miles of the section, at an estimated cost of \$724,129.71 (first estimated at \$700,129.71) for original work and \$20,000 annually for maintenance. For map see Annual Report for 1913, page 2500.

Condition at the end of fiscal year.—The project was 72 per cent completed. The available extreme low-water depth had been increased to 3 feet. The total amount expended under the present project, exclusive of outstanding liabilities, was \$518,754.61 for new work and \$2,395.65 for maintenance, a total of \$521,150.26. This section of the river is usually navigable for 4-foot draft throughout the year; for 5-foot draft from December 1 to September 1; and for 6-foot draft from December 15 to August 15. Four-foot navigation is possible when the Florence gauge reads -0.2 . For each additional foot of navigable depth add 0.6 on the gauge.

Effect of improvement.—The increased depth has lengthened the navigable season for 6-foot draft by about three months. Freight rates have probably been affected, but information as to extent is not available.

Proposed operations.—With the funds available for the fiscal year 1917 it is proposed to complete the improvements at all of the principal obstructions below Riverton and to maintain the completed channels by the removal of surface obstructions and redredging where necessary. The following estimate is submitted:

Operation and repair of dredge <i>Kentucky</i> and attendant plant 7 months, at \$7,000 per month	\$49,000
Operation and repair of dredge <i>Watauga</i> and attendant plant 7 months, at \$7,000 per month	49,000
Operation and repair of dredge <i>Tishomingo</i> and attendant plant 7 months, at \$7,000 per month	49,000
Maintenance of the completed channels	8,000
Engineering and contingencies	36,000
Total	191,000

With the funds to be appropriated for the fiscal year 1918 it is proposed to complete the open-channel work at all of the remaining shoals in the section and to maintain the completed channels by the removal of surface obstructions and dredging where necessary. These improvements are necessary in order to provide sufficient depth for navigation throughout the year by the principal boats operating in this section. The work will be done before the end of the calendar year 1918, in accordance with the following estimate:

Operation and repair of dredge <i>Kentucky</i> , and attendant plant, one-half month, at \$7,000 per month-----	\$3, 500
Operation and repair of dredge <i>Watauga</i> , and attendant plant, one-half month, at \$7,000 per month-----	3, 500
Operation and repair of dredge <i>Tishomingo</i> , and attendant plant, one-half month, at \$7,000 per month-----	3, 500
Maintenance of the completed channels-----	10, 000
Engineering and contingencies-----	5, 500
Total -----	26, 000

Commercial statistics.—The total commerce below Florence for the calendar year 1915 amounted to 471,006 short tons, valued at \$5,624,908. Of the total commerce, 3 per cent was farm products; 34 per cent rafted logs, lumber, ties, and poles; 3 per cent boated logs and lumber; 54 per cent boated ties; and 6 per cent merchandise, flour, fertilizer, and miscellaneous. The following table gives a comparative statement of the total commerce below Florence for the calendar years indicated:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	373, 625	\$6, 261, 650
1914.....	480, 105	6, 130, 874
1915.....	471, 006	5, 624, 908

Omitting sand and gravel and rafted timber products, the traffic for 1913 was 427,900 tons; for 1914, 268,800 tons; and for 1915, 311,400 tons.

Amount expended on all projects from July 25, 1868, to June 30,

1916:

New work-----	\$965, 503. 67
Maintenance-----	101, 741. 83
Total -----	1, 067, 245. 50

Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement-----	16, 000. 00
For maintenance of improvement-----	10, 000. 00
Total -----	26, 000. 00

TOLEDO HARBOR, OHIO.

Location and description.—Toledo Harbor comprises the lower 7 miles of Maumee River and the channel about 9 miles long through Maumee Bay to Lake Erie. It is located at the westerly end of Lake Erie 99 miles westerly from Cleveland, Ohio.

Existing project.—The existing project, adopted by the river and harbor act of March 3, 1899, provided for a channel 21 feet deep at mean lake level, 400 feet wide from deep water in Lake Erie through Maumee Bay and Maumee River to Fassett Street Bridge, a distance of about 15 miles, and 200 feet wide for a distance of about 1 mile farther upstream, terminating in a turning basin 500 feet wide; and for a stone-revetted earth dike, 1,000 feet long, to form a foundation for range lights in the bay; all at an estimated cost of \$1,005,000. (H. Doc. No. 198, 55th Cong., 2d sess.)

The river and harbor act of June 25, 1910, modified the project by providing for dredging the channel 23 feet deep at mean lake level, except in that portion above Fassett Street Bridge, at an additional cost of \$400,000. (H. Doc. No. 865, 60th Cong., 1st sess.) This estimate was later increased to \$500,000.

The existing project as revised provides for a channel 400 feet wide and 23 feet deep from deep water in Lake Erie through Maumee Bay and Maumee River to Fassett Street Bridge, a distance of 15 miles, 200 feet wide and 21 feet deep for a distance of 1 mile above Fassett Street Bridge, terminating in a turning basin 500 feet wide; and for a stone-revetted earth dike, 1,000 feet long, to form a foundation for range lights in Maumee Bay. The total estimated cost of the work above described was \$1,505,000, with annual maintenance of \$35,000. For the latest published map of Toledo Harbor, see page 3056 of Annual Report for 1914.

Condition at end of fiscal year. The existing project was about 97 per cent completed at the end of the fiscal year. A channel 400 feet wide and 23 feet deep at mean lake level, extending from deep water in the lake through Maumee Bay and River up to Fassett Street Bridge, a distance of 15 miles, was completed in October, 1915. The full width of the channel has not been maintained, depths on both sides varying from 19 to 23 feet. Above Fassett Street Bridge a channel 100 feet wide and 21 feet deep has been obtained, but since this portion of the river has fallen into complete disuse commercially there is no apparent need for completing and maintaining the improvement in this locality, and depths have decreased to about 19 feet. The dike in Maumee Bay was completed in 1906. The maximum draft available at the end of the fiscal year was 23 feet at mean lake level up to Fassett Street Bridge, and 19 feet for 1 mile farther upstream. The total expenditures under the existing project to the end of the fiscal year amounted to \$1,570,279.76, of which \$1,267,406.91 was for new work and \$302,872.85 was for maintenance since 1903, prior to which time the amounts expended for works of improvement and for maintenance were so involved that it is impracticable to separate them.

Local cooperation.—None directly provided by law. The city of Toledo has expended about \$300,000 in dredging and bulkhead construction, which has resulted in providing a lagoon near the mouth of the river suitable for the winter mooring of vessels and in the maintenance of a channel through Swan Creek, which empties into Maumee River within the limits of the Federal project.

Effect of improvement.—The improved channel has made the commercial development of Toledo Harbor possible, about 95 per cent of the tonnage being handled in vessels drawing 19 to 20 feet, whereas

the natural channel was but 12 feet deep. Competition among vessel men as a result of these improvements has reduced rates on the principal commodities, ore and coal, below possible competition by railroads. Rail rates on grain and certain classes of packet freight are probably affected to an undetermined extent by vessel competition.

Proposed operations.—It is expected that the funds now available will be exhausted by June 30, 1917. It is estimated that \$35,000 is needed for necessary work of maintenance to June 30, 1918.

Commercial statistics.—During the calendar year 1915, 88 per cent of the total tonnage of the port was coal and iron ore, practically all of which was handled in vessels drawing 19 to 20 feet. All vessels entering Toledo Harbor pass through 9 miles of the 15 miles of improved channel and proceed upstream to the various docks located along the 6 miles of river channel.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	7,510,634	\$25,355,100
1914.....	7,166,172	22,286,168
1915.....	7,416,834	33,953,807

Amount expended on all projects from June 23, 1866, to June 30, 1916:

New work.....	\$2,892,102.36
Maintenance (since 1903).....	302,872.85

Total.....	3,194,975.21
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Balance available for fiscal year ending June 30, 1917.....	\$37,753.91
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	35,000.00
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PORT CLINTON HARBOR, OHIO.

Location and description.—Port Clinton Harbor comprises the lower half mile of the Portage River, which empties into Lake Erie at a point 72 miles, westerly from Cleveland, Ohio.

Existing project.—The existing project was inaugurated by the river and harbor act of June 10, 1872 (no printed report), which provided for "Improving Port Clinton Harbor," no definite project being stated. Funds appropriated from time to time since the improvement was undertaken have been applied to obtaining and maintaining a channel across the bar at the mouth of the river. The present project is regarded as providing for parallel stone and pile jetties at the mouth of the river extending to a depth of 12 feet below mean lake level in the lake, for dredging a channel to a depth of 12 feet, and for maintenance of the improvement. It was estimated, in 1883, that the improvement would cost \$90,000. The river and harbor act of July 13, 1892, provided for the purchase of a tract of land adjoining the inner end of the west jetty. The purchase was completed in 1894. For latest published map of Port Clinton Harbor, see House Document No. 815, Sixty-first Congress, second session.

Condition at the end of fiscal year.—The project, except for maintenance, was completed. The river entrance had been improved by the construction of approximately parallel jetties about 200 feet apart, with an aggregate length of 4,180 feet, which were completed in 1883. A channel 12 feet deep below mean lake level and from 100 to 200 feet wide had been provided from deep water in the lake up the river for a distance of about 800 feet above the inner ends of the jetties. Dredging was completed in 1893. The jetties have deteriorated to such an extent that minor repairs will be necessary in the near future. The maximum draft available at the end of the fiscal year was 11 feet. Total expenditures under the present project to the end of the fiscal year were \$106,505.54, of which \$71,949.86 was for new work and \$34,555.68 was for maintenance since 1894, prior to which time the amounts expended for works of improvement and for maintenance were so involved that it is impracticable to separate them.

Effect of improvement.—Such commerce as exists at this port has been made possible by the improvement of the river as, in its natural condition, it was entirely unsuited to the needs of navigation. It has never been sufficiently developed, however, to accommodate the large type of vessels which now handle the bulk commodities—iron ore and coal—which form the greater portion of lake commerce. Therefore, while of benefit to local small craft, the improvement has probably not resulted in any reduction of either rail or water rates.

Proposed operations.—(a) The work indicated as proposed in the last annual report has not yet been done. With funds then on hand and additional amount since appropriated, it is proposed to repair with riprap the jetties at the harbor entrance. A rock in the channel of approach should be removed. Available funds will be expended (approximately) as follows:

Part maintenance of district office.....	\$100
Repair of jetties by Government plant, hired labor, and purchase of about 500 tons of riprap.....	1,150
Part maintenance of district inspection boat.....	250
Total	1,500

The fund for repair of jetties will probably be expended in a single month. Available funds will be exhausted June 30, 1917.

(b) It is estimated that an appropriation of \$500 will be needed during the fiscal year ending June 30, 1918, for transaction of Government business pertaining to this harbor and for share of general expenses of the district office.

Commercial statistics.—The commerce of this port is comparatively unimportant. It is a base for the fishing industry, and there is a limited traffic in lumber and coal.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	6,413	\$208,555
1914.....	6,645	222,735
1915.....	9,009	162,795

Amount expended on all projects from June 10, 1872, to June 30, 1916:

New work	\$71, 949. 86
Maintenance (since 1894)	34, 555. 68
Total	106, 505. 54
Balance available for fiscal year ending June 30, 1917	1, 487. 20
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	500. 00

SANDUSKY HARBOR, OHIO.

Location and description.—Sandusky Harbor is located in the southeasterly portion of Sandusky Bay, a natural harbor, some 22½ square miles in area, which opens into Lake Erie and is about 57 miles westerly from Cleveland, Ohio. It comprises the channel through the outer bar and through the bay, a distance of about 2 miles, and along the city front, which is developed for a distance of about 1½ miles.

Condition at the end of fiscal year.—The channel authorized by the project, described under "Existing project," was completed in 1915; the east jetty had been extended 5,000 feet from Cedar Point, work being completed in 1915; a length of 108 feet of the west jetty, 800 feet of the sill, the spur dike at Cedar Point, and the revetment of the slope near the front range light were completed in 1901. The protection works, so far as completed, had proved reasonably effective in maintaining channel depths at the entrance to the bay. The protecting works are generally in good condition, except the stone sill, which has been leveled off by the action of the seas. A depth of 21 feet at mean lake level was available throughout the length of the channel, although its full width had not been maintained. As the project channel has been secured without the construction of certain of the proposed protecting works these works are considered unnecessary, and the project is regarded as having been completed at a saving of \$210,000 as compared with the original estimate. Total expenditures under the existing project to the end of the fiscal year were \$820,847.32, of which \$729,740.21 was for new work and \$91,107.11 was for maintenance since 1903, prior to which time the amounts expended for works of improvement and for maintenance were so involved that it is impracticable to separate them.

Local cooperation.—None directly provided by law. The city of Sandusky has expended approximately \$160,000 in constructing two municipal wharves and in excavating rock from the channel in front of the city.

Effect of improvement.—The effect of the improvement has been to provide a direct channel used by all vessels entering or leaving Sandusky Harbor about 12 feet deeper than the indirect natural channel. At least 80 per cent of the traffic of the port is conducted by vessels which avail themselves of the full project depth. Water rates on bulk commodities, except grain, have been reduced by improved conditions on the Lakes and by competition among vessel men below possible rail competition.

Proposed operations.—It is expected that funds now available will be exhausted June 30, 1917, and an estimate of \$10,000 is submitted for necessary work of maintenance in the fiscal year 1918.

Commercial statistics.—The shipment of coal amounts to about 80 per cent of the total business of the harbor. The remainder of the commerce of the harbor is miscellaneous in character and is handled by lighter draft vessels.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	3, 253, 954	\$10, 593, 104
1914.....	3, 129, 776	12, 778, 376
1915.....	3, 234, 895	12, 733, 219

Amount expended on all projects from June 11, 1844, to June 30, 1916:	
New work.....	\$1, 206, 889. 30
Maintenance (since 1903).....	91, 107. 11
Total	1, 297, 996. 41
Balance available for fiscal year ending June 30, 1917.....	14, 045. 01
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	10, 000. 00

SANDUSKY HARBOR, OHIO—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 982, Sixty-fourth Congress, first session.

The present project for improvement of this harbor was adopted by the act of March 3, 1899, and as subsequently modified now provides for a channel 21 feet deep at mean lake level, 400 feet wide from deep water in the lake to Cedar Point, and through the straight channel to the city water front, and 300 feet wide along the dock channel, increasing to 550 feet at the westerly end to form a turning basin; and for protection works, including an east jetty 5,000 feet long, a west jetty 5,550 feet long, a deflecting dike 1,500 feet long parallel to the straight channel in the bay, a short spur at Cedar Point, a brush and stone sill extending from the front range light to Sand Point, three short spurs to protect the eastern shore of Sand Point, and the revetment of the slope adjacent to the channel in the vicinity of the front range light, the estimated cost of completion, as revised in 1903, being \$1,135,000, after an expenditure of \$477,149.09 under previous projects. Exclusive of maintenance, there has been expended on this project to January 1, 1916, the sum of \$729,740.21, resulting in securing in all channels the project depth but not the full project width, the construction of the east jetty, the short spur from Cedar Point, the revetment of the channel slope in the vicinity of the front range light, 800 feet of the sill between this light and Sand Point, and 108 feet of the west jetty. Under authority of the act of March 4, 1913, a report was submitted and published in House Document No. 871, Sixty-third Congress, second session, in which recommendation was made for an extension of the east jetty to a total length of 6,000 feet with a pierhead at its outer end, for dredging the outer bar channel, the straight channel, and the eastern part of the dock channel to a depth of 23 feet at mean lake level, and for excavating the western part of the dock channel to a depth of 22 feet at mean lake level, at a total estimated cost of \$282,000, subject to the contribution of \$50,000 toward the improvement by the city of Sandusky. The district officer now believes that it is advisable to further modify the project by increasing the depth of all channels to 23 feet below mean lake level, omitting the area in the west dock channel marked "A" on the accompanying map, and eliminating from the project the provisions for the construction of a sill between Sand Point and the front range light, the three small jetties to protect the eastern shore line of Sand Point, the west jetty, and the deflecting dike opposite and parallel to the outer portion of the straight channel. The division engineer concurs with the district officer, except as to

the depth of the westerly portion of the dock channel, which he recommends be limited to 22 feet on account of excessive cost of rock removal. The Board of Engineers for Rivers and Harbors concurs in the views of the division engineer.

I concur in the views of the division engineer and the Board of Engineers for Rivers and Harbors, and therefore recommend legislation authorizing a modification of the project for improvement of Sandusky Harbor, Ohio, so as to eliminate its nonessential features as indicated by the district officer and to provide for its completion by extension of the east jetty to a total length of 6,000 feet, with suitable pierhead; dredging outer channel and straight channel 400 feet wide and easterly portion of dock channel 300 feet wide, 23 feet deep at mean lake level, and excavating westerly dock channel 300 feet to 550 feet wide and 22 feet deep at mean lake level, omitting area "A" as shown on map, all at an estimated cost of \$231,000, and \$10,000 annually for maintenance, provided that the city of Sandusky or other local interests shall contribute toward the work the sum of \$50,000. The balance of \$181,000, to be provided by the United States, should be made available in one appropriation.

HURON HARBOR, OHIO.

Location and description.—Huron Harbor is located at the mouth of Huron River, which flows into Lake Erie 48 miles westerly from Cleveland, Ohio. It comprises the lower mile of Huron River, an outer harbor some 14 acres in area, and a channel of approach.

Existing project.—The existing project, adopted by the river and harbor act of March 3, 1905 (H. Doc. No. 122, 58th Cong., 2d sess., and Annual Report for 1904, p. 3209), provides for rebuilding 580 feet of the west pier with concrete superstructure, extending it 240 feet, and constructing a stone-filled, timber-crib pierhead with concrete superstructure 50 feet square at its outer end; for a second pierhead of the same type and dimensions and 300 feet easterly from it; for a rubble-mound breakwater extending from this east pierhead to a point on shore 1,200 feet easterly from the channel; for the removal of the old east pier; for dredging a channel of approach 300 feet wide and 21 feet deep at mean lake level; and for dredging the area of about 14 acres sheltered by the breakwaters to a depth of 21 feet at mean lake level. The total estimated cost of the work was \$315,500, with annual maintenance at \$2,500. For the latest published map of Huron Harbor see House Document No. 5, Sixty-third Congress, first session.

Condition at the end of fiscal year.—The project was completed—the jetties in 1908, the dredging in 1911. As a maintenance measure the west jetty was extended shoreward 120 feet in 1914, to close a breach which had formed between the river and the lake, endangering the channel. Harbor works are generally in good condition, except the superstructure of the inner portion of the west pier which is of timber construction and is rapidly deteriorating. A depth of 21 feet at mean lake level was available in the harbor, except in the sheltered area in the outer basin which has not been maintained, as the area is too restricted for the shelter or maneuver of the large vessels. The total expenditures under the existing project to the end of the fiscal year were \$305,432.60, of which \$198,478.43 was for new work and \$106,954.17 was for maintenance.

Local cooperation.—None directly provided by law. The Wheeling & Lake Erie Railroad Co. has expended approximately \$90,000 in deepening and maintaining the channel above the limits of the Federal improvement.

Effect of the improvement.—The improvement of Huron Harbor has made its commercial development possible, as in its natural condition it was entirely unsuited to the needs of navigation. Rail rates have been little affected by the improvement, as 92 per cent of the business of the port is the transshipment of iron ore and coal, the water rates on which have been so greatly reduced by improved conditions on the **Great Lakes** (of which the improvement of Huron Harbor is a part) as to preclude the possibility of rail competition.

Proposed operations.—It is expected that available funds will be exhausted June 30, 1917, and an estimate of \$4,000 is submitted for necessary work of maintenance in the fiscal year 1918.

Commercial statistics.—About 92 per cent of the business of the port is the transshipment of coal and iron ore.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	2,557,932	\$6,534,610
1914.....	1,407,355	3,790,343
1915.....	1,406,005	4,089,159

Amount expended on all projects from May 20, 1826, to June 30,

1916:

New work.....	\$468,267.50
Maintenance (since 1903).....	106,954.17

Total.....	575,221.67
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Balance available for fiscal year ending June 30, 1917.....	4,028.44
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	4,000.00
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VERMILION HARBOR, OHIO.

Location and description.—Vermilion Harbor is located at the mouth of Vermilion River, which empties into Lake Erie at a point about 39 miles westerly from Cleveland, Ohio. It comprises the lower 3,000 feet of Vermilion River and a channel of approach from the lake.

Existing project.—The existing project provides for improving the harbor entrance by constructing parallel piers 125 feet apart, with an aggregate length of 2,200 feet, extending from the shore at the mouth of the river to a natural depth of 12 feet in the lake, and by dredging a channel 100 feet wide and 14 feet deep below mean lake level between the piers and beyond them to deep water in the lake. The general project was adopted by the river and harbor act of July 4, 1836, and, by the river and harbor act of March 3, 1875, was modified to provide a 14-foot instead of a 12-foot depth, as first authorized. (Annual Report for 1874, p. 219.) A thorough repair of the piers was authorized by the river and harbor act of March 3, 1905. (H. Doc. No. 252, 58th Cong., 2d sess.) The estimated cost of the work above described was \$127,692. No estimate of the annual cost of maintenance was made. For the latest published map of Vermilion Harbor see page 2128, Annual Report for 1909.

Condition at the end of fiscal year.—The work contemplated by the project was completed about 1878. The river mouth has been

improved by the construction of parallel piers 125 feet apart and by dredging a channel with a general depth of 14 feet at mean lake level between the piers to deep water in the lake. The harbor works were generally in fair condition at the end of the fiscal year, except that minor repairs to the stone superstructure of the west pier have become necessary. A mean depth of 13.7 feet at mean lake level was available in the jettied channel and the approach thereto. Total expenditures under the existing project to the end of the fiscal year were \$170,623.43, of which \$133,277.55 was for new work and \$37,345.88 was for maintenance (since 1903), prior to which time the amount expended for works of improvement and for maintenance were so involved it is impracticable to separate them.

Local cooperation.—There has been no local cooperation. A small amount was expended by the village of Vermilion and local interests during the fiscal year 1915 for widening and deepening the river above the limits of the Federal project.

Effect of improvement.—The improvement has made possible the limited use of Vermilion Harbor, as in its natural condition it was entirely unsuited to the needs of navigation. The improvement has had no effect on either rail or water rates, as it does not provide facilities for the larger type of vessels which handle the greater part of the commerce on the Great Lakes. Vermilion is primarily a fishing harbor, and the facilities are sufficient for the conduct of this business.

Proposed operations.—(a) The west pier is in need of repair to prevent the stone superstructure from falling into the channel. The balance available will be expended as follows:

Maintenance of district office and inspection boat.....	\$350
Repair of west pier by Government plant and hired labor.....	4,150
Total	4,500

It is estimated that available funds will be exhausted December 31, 1916.

(b) It is estimated that an appropriation of \$500 will be needed for the fiscal year ending June 30, 1918, for occasional inspection and transaction of miscellaneous Government business connected with the maintenance of this harbor.

Commercial statistics.—Vermilion Harbor is almost exclusively used by the fishing interests. All vessels entering or leaving Vermilion Harbor make use of the improvement.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	748	\$75,000
1914.....	1,146	112,967
1915.....	982	78,576

Amount expended on all projects from Mar. 3, 1875, to June 30.

1916:

New work.....	\$133,277.55
Maintenance (since 1903).....	37,345.88

Total	170,623.43
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Balance available for fiscal year ending June 30, 1917.....	\$4,500.00
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	500.00
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LORAIN HARBOR, OHIO.

Location and description.—Lorain Harbor is located at the mouth of Black River, which flows into Lake Erie about 30 miles westerly from Cleveland, Ohio. It comprises an outer harbor some 60 acres in area, created by the construction of breakwaters and the lower 3 miles of Black River.

Existing project.—The several features of the existing project were authorized by river and harbor acts as follows: Act of March 3, 1899, rebuilding entrance piers, constructing outer breakwaters, and dredging in channel between the piers (H. Doc. No. 131, 55th Cong., 2d sess., and Annual Report for 1898, p. 2718); act of June 6, 1900, increasing estimate of cost (Annual Report for 1900, p. 4057); act of March 2, 1907, widening Black River from the inner end of the easterly Government pier to Erie Avenue Bridge (no printed report); act of March 3, 1909, extending west breakwater toward shore (no printed report); and act of June 25, 1910, extending breakwaters shoreward and dredging in outer harbor (H. Doc. No. 644, 61st Cong., 2d sess.).

The existing project as modified provides for an outer harbor about 60 acres in area, created by converging rubble-mound breakwaters, with an aggregate length of 5,600 feet, and having an entrance 500 feet wide between pierheads of timber cribs with concrete superstructure located at the outer ends of the breakwaters and 1,800 feet outside the entrance to the channel between the piers; for dredging the outer harbor to a depth of 21 feet below mean lake level; for parallel piers of timber cribs with concrete superstructure at the mouth of the river 300 feet apart and having an aggregate length of 2,765 feet; and for dredging the channel between the piers and upstream to the Erie Avenue Highway Bridge, a length of about 3,000 feet, to a depth of 20 feet below mean lake level. The estimated cost of the work above described was \$968,479, with annual maintenance at \$5,000. For the latest published map of Lorain Harbor see House Document No. 980, Sixty-fourth Congress, first session.

Condition at the end of fiscal year.—The project had been completed at a cost of about \$160,500 less than the original estimate. The river entrance had been improved by the construction of parallel piers and dredging up to the Erie Avenue Bridge, providing a channel 21 feet deep at mean lake level and about 250 feet wide. An outer harbor about 60 acres in area had been provided by constructing breakwaters and by dredging to a depth of 21 feet below mean lake level. The piers were completed in 1908, the breakwaters, including pierhead, in 1915, and the dredging in 1913. At the end of the fiscal year the harbor works were in good condition. A depth of 21 feet at mean lake level was available in the entrance channel, the channel between the piers, and over the greater portion of the sheltered area of the outer harbor. Expenditures under the existing project to the end of the fiscal year were \$871,397.06, of which \$807,715.46 was for new work and \$63,681.60 was for maintenance since 1903, prior to which time the amounts expended for works of improvement and for maintenance were so involved that it is impracticable to separate them.

Local cooperation.—None directly provided by law. The city of Lorain has expended approximately \$550,000 in obtaining and main-

taining a channel in Black River above the Erie Avenue Bridge to the plant of the National Tube Co., located about 3 miles above the mouth of the river, and in constructing a public dock. The channel is 120 to 200 feet wide and 22 feet deep below mean lake level.

Effect of improvement.—The improvement of Lorain Harbor has made its commercial development possible, as in its natural condition it was entirely unsuited to the requirements of navigation. Water rates on the principal commodities—iron ore and coal—have been greatly reduced by improved conditions on the Great Lakes, of which the improvement of Lorain Harbor is a part. Water transportation enjoys an almost complete monopoly in the movement of bulky commodities, which include practically all of the commerce of Lorain Harbor. The railroads can not compete for this commerce and the rail rates have, therefore, been little affected by the improvement.

Proposed operations.—It is estimated that necessary work of maintenance to June 30, 1918, will cost about \$24,700, thus requiring an additional appropriation of \$5,000, and an estimate for this sum is submitted.

Commercial statistics.—All vessels entering or leaving Lorain Harbor make use of the improvement. Iron ore and coal form 98 per cent of the total tonnage of the port and practically all vessels engaged in this trade have a draft of 19 to 20 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	8,609,897	\$23,327,877
1914.....	4,507,075	11,517,228
1915.....	7,010,460	20,695,954

Amount expended on all projects from May 23, 1828, to June 30, 1916:

New work.....	\$1,099,918.34
Maintenance (since 1903).....	63,681.60
Total.....	1,163,599.94

July 1, 1916, balance available.....	19,742.14
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	5,000.00

LORAIN HARBOR, OHIO—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 980, Sixty-fourth Congress, first session:

Under the project for improvement of Lorain Harbor there have been constructed an east breakwater 2,300 feet long and a west breakwater 3,300 feet long. After the beginning of work on the west breakwater in 1906, the beach for some distance adjacent to the inner end of the breakwater began to erode. The district officer states that the original beach has entirely disappeared and the wave action has carried away 20 to 40 feet of the bluff. It seems probable that nearly all of the material eroded has been deposited in the westerly portion of the harbor. He believes that this erosion has been caused very largely by the breakwater structure, and to prevent further shore erosion and consequent fill in the harbor he recommends that the west breakwater be extended to the shore, the

cost of which, including a spur 200 feet long to deflect the waves, is estimated at \$22,500, of which local interests have offered to contribute \$3,000. While considerable erosion has taken place on the east side of harbor, the investigation indicates that this has not been due to the presence of the breakwaters. The division engineer concurs in the views of the district officer.

The Board of Engineers for Rivers and Harbors concurs with the district officer and the division engineer as to the advisability of extending the west breakwater to the shore, but it does not believe that the construction of the proposed spur is necessary. Omitting this item the estimated cost of the work becomes \$19,500.

I concur in the views of the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Lorain Harbor, Ohio, with a view to preventing erosion of banks, if any, caused by the extension of the Government breakwaters on either side of the harbor, is deemed advisable to the extent of extending the west breakwater to the shore, at an estimated cost of \$19,500, provided local interests contribute toward this work the sum of \$3,000.

CLEVELAND HARBOR, OHIO.

Location and description.—Cleveland Harbor is on the south shore of Lake Erie at the mouth of the Cuyahoga River, 99 miles easterly from Toledo, Ohio, which is at the westerly end of the lake, and 175 miles southwesterly from Buffalo, N. Y., which is at the easterly end of the lake. The harbor comprises the lower 5 miles of Cuyahoga River and an outer harbor formed by breakwaters about 5 miles in length.

Existing project.—The several features of the existing project were authorized by river and harbor acts as follows: Act of June 3, 1896, rebuilding piers and completing east breakwater (H. Doc. No. 326, 54th Cong., 1st sess., and Annual Report for 1896, p. 2949); act of March 3, 1899, as modified by act of June 13, 1902, dredging to 21 feet and 25 feet depth (H. Doc. No. 156, 55th Cong., 3d sess., and Annual Report for 1899, pp. 3075 and 3078); act of June 13, 1902, new harbor entrance and breakwater extension (H. Doc. No. 118, 56th Cong., 2d sess., and Annual Report for 1901, p. 3277); act of March 2, 1907, wharf and storehouse (H. Doc. No. 270, 59th Cong., 2d sess.); act of June 25, 1910, closing gap in east breakwater (report not printed).

The existing project as modified provides for improving the river mouth by reconstructing the piers with stone-filled timber cribs and concrete superstructure, and enlarging the channel between them to a width of 325 feet and a depth of 25 feet below mean lake level for a length of about 2,000 feet, measured from the outer end of the piers; for increasing the outer harbor area by removing the shore arm previously built opposite the foot of East Ninth Street, and extending the east breakwater about 3 miles to a point opposite Gordon Park with a rubble-mound structure; for repairing the older portion of the east breakwater; for deepening the outer harbor to 25 feet below mean lake level, at the discretion of the Secretary of War; for improving the main entrance to the harbor by increasing its width from 500 to 700 feet, and protecting it by converging rubble-mound breakwaters extending lakeward from the main breakwater; and for constructing a stone-filled wooden pile wharf and reinforced concrete storehouse at the foot of East Ninth Street.

The total estimated cost of the work above described was \$6,439,456, including dredging to a depth of 21 feet in the outer harbor, or

\$6,626,456, including dredging to a depth of 25 feet in the outer harbor. No estimate was made of the annual cost of maintenance. For the latest published map of Cleveland Harbor, see page 3278 of Annual Report for 1915.

Conditions at the end of fiscal year.—The project, so far as definitely authorized by Congress, was regarded as about 95 per cent completed. The river entrance channel had been improved by the construction of parallel jetties 325 feet apart and dredging to a depth of 25 feet at mean lake level up to the New York Central Railroad bridge. The piers were completed in 1900 and the dredging in 1909. Above the New York Central Railroad bridge the work of widening the river had been delayed through inability on the part of the city of Cleveland to secure satisfactory title to the required land. The outer harbor, about 5 miles long, 3,000 to 4,000 feet wide, and about 1,300 acres in extent, had been formed by the construction of an aggregate length of about 28,000 feet of breakwater, completed in 1915. The harbor thus formed had been closed at its westerly limits by an arm extending from the outer breakwater to the shore. The main entrance had been widened to 700 feet and protected by converging arms extending lakeward from the east and west breakwaters. The outer harbor had been deepened, 1905–1909, to 25 feet at mean lake level throughout the west basin, in the entrance channel, and over a portion of the east basin adjacent to the entrance channel. Over the remaining portion of the east basin, as far east as East Ninth Street, a depth of 21 feet at mean lake level had generally been secured. A wharf was built at the foot of East Ninth Street in 1910 and a storehouse in 1915. Piers and breakwaters were generally in good condition at the end of the fiscal year, except that portion of the east breakwater between the main entrance and a point opposite the foot of East Ninth Street, where the timber superstructure was badly decayed. Minor repairs to the rubble mound portion of the east breakwater were also necessary. Depths in the entrance channel and outer basins have not been maintained. At the end of the fiscal year the available depth was about 21 feet at mean lake level. Expenditures under the existing project to the end of the fiscal year were \$5,991,761.59, of which \$5,177,820.74 was for new work and \$813,940.85 was for maintenance since 1903, prior to which time the amounts expended for works of improvement and for maintenance were so involved that it is impracticable to separate them.

Local cooperation.—None directly provided for by law. River widening can not be completed, however, until the city of Cleveland secures and turns over to the Government satisfactory title to the land required for the purpose.

Outside of the project, the improvement and maintenance of the inner harbor, consisting of about 7 miles of the Cuyahoga River and "Old River," have been assumed by the city of Cleveland, the funds required for this work being taken from general and special tax levies. There has been expended to date about \$3,810,000. The channel width is in general 200 feet, and a depth of about 22 feet below mean lake level is maintained. The city has also built a bulkhead extending along the lake front a distance of about 2,500 feet westerly from East Ninth Street and two piers, one of which has been leased to passenger-vessel companies. Of these improvements,

the last two items are within the limits of the Federal project for the harbor; the others are beyond these limits.

Effect of improvement.—The improvement has made the development of Cleveland Harbor possible as, in its natural condition, it was entirely unsuited to the needs of navigation. Although not primarily intended for the purpose, Cleveland Harbor is extensively used as a harbor of refuge. Improved conditions on the Great Lakes, of which Cleveland Harbor is a part, have resulted in a very great reduction in water rates. Water rates on the bulk commodities, iron ore and coal, which comprise about 87 per cent of Cleveland's commerce, have been reduced below possible rail competition. Rail rates on other commodities have been affected to an indeterminate extent by the improvement.

Proposed operations.—Bids have been received for rebuilding the superstructure of 1,550 linear feet of breakwater, and it is proposed soon to let a contract for the remaining 1,750 linear feet. It is estimated that the entire work will be completed about July 31, 1917. The rubble mound portion of the east breakwater, damaged during the storms of November and December, 1913, has not been repaired. The present condition is practically the same as immediately after the storm, but further and serious damage may result at any time if the breakwaters in their present condition are subjected to severe storms. The necessary expenditures to June 30, 1918, are estimated as follows:

Part maintenance of district office.....	\$7, 200
Harbor patrol boat.....	3, 000
Maintenance of field office, storehouse, and repair shop.....	10, 700
Rebuilding with stone the damaged timber crib portion of east breakwater, 3,300 linear feet.....	139, 500
Repair of 2,000 linear feet of rubble mound east breakwater.....	32, 000
Operation and maintenance of U. S. dredges <i>Burton</i> 4½ months and <i>Maumee</i> 1 month.....	20, 500
Part maintenance of district inspection boat.....	3, 000
Construction of storehouse.....	2, 800
Part cost of new district inspection boat and dump scow.....	15, 000
Dredging shoal areas in outer harbor under contract.....	32, 000
Complete riprap protection of 2,200 linear feet of west breakwater.....	50, 000
Repair of 4,000 linear feet of rubble mound east breakwater.....	43, 000
Total.....	358, 700

The above work will require an additional appropriation of \$60,000, and an estimate for this sum is submitted.

Commercial statistics.—Of the tonnage of the port, 87 per cent is iron ore and coal, handled in vessels with a draft of 19 to 20 feet. The remaining 13 per cent of the commerce is miscellaneous in character, including considerable quantities of lumber, stone, grain, packet freight, manufactured iron, and oil.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	16, 488, 083	\$82, 762, 000
1914.....	10, 912, 572	50, 979, 660
1915.....	12, 631, 442	134, 949, 361

Amount expended on all projects from March 3, 1825, to June 30, 1916:

New work -----	\$6, 741, 974. 30
Maintenance (since 1903) -----	813, 940. 85
Total -----	<u>7, 555, 915. 15</u>
Balance available for fiscal year ending June 30, 1917 -----	298, 770. 97
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement -----	60, 000. 00

FAIRPORT HARBOR, OHIO.

Location and description.—Fairport Harbor is located at the mouth of the Grand River, which empties into Lake Erie 34 miles easterly from Cleveland, Ohio. It comprises an outer harbor some 40 acres in area and the lower mile of Grand River.

Existing project.—The several features of the existing project were authorized by the following river and harbor acts: Act of June 3, 1896, constructing outer breakwaters and dredging sheltered area (H. Doc. No. 347, 54th Cong., 1st sess., and Annual Report for 1896, p. 2956); estimate of cost modified in 1900 (Annual Report for 1900, p. 2349); act of March 3, 1905, extending west breakwater to a point at or near the shore (Annual Report for 1903, p. 2084, and Annual Report for 1905, p. 2349).

The existing project as revised provides for parallel piers at the entrance to the inner harbor about 200 feet apart and 1,100 feet long; for an outer harbor about 40 acres in area; the construction of protecting breakwaters; and dredging to a depth of 20 feet at mean lake level in the channels and protected area. The west breakwater, as provided by the project, begins on shore and extends north, thence northeasterly a distance of 3,378 feet, terminating in a pierhead at its outer end. The east breakwater begins at a pierhead located 600 feet easterly from the west pierhead and extends shoreward a distance of 1,350 feet (including pierhead). The river piers are of timber crib construction. The breakwaters, except about 830 feet of the west breakwater (which is of timber-crib construction), are rubble-mound structures. The pierheads are stone-filled timber cribs, with concrete superstructures. The estimated cost of the work above described was \$705,000. No estimate of the annual cost of maintenance was made. For the latest published map of Fairport Harbor see House Document No. 206, Sixty-third Congress, first session.

Condition at the end of fiscal year.—The harbor had been improved by the construction of parallel piers 180 feet apart at the mouth of Grand River, the aggregate length of portions now maintained being 2,320 feet; by the construction of outer breakwaters with a total length of 4,728 feet, sheltering an area of about 40 acres; and by dredging the channel between the piers and through the outer harbor to a depth of 20 feet at mean lake level, this depth, however, having been increased to about 22 feet by natural scour. The piers were completed in 1904 and the breakwaters in 1913. The project was 96 per cent completed. The only work included therein which has not been done is the dredging of a portion of the outer harbor, which is not immediately required. The outer ends of both piers and the timber superstructure of the timber portion of the west

breakwater have deteriorated to a considerable extent, but otherwise the harbor works are in good condition. Expenditures under the existing project to the end of the fiscal year were \$757,676.27, of which \$608,222.09 was for new work and \$149,454.18 was for maintenance since 1903, prior to which time the amounts expended for works of improvement and for maintenance were so involved that it is impracticable to separate them.

Local cooperation.—None directly provided by law. The Baltimore & Ohio Railroad Co. has expended about \$50,000 in obtaining and maintaining a channel in the river with an available depth of 20 feet at mean lake level for about 1 mile above the limits of the Federal project.

Effect of improvement.—The improvement has made the commercial development of Fairport Harbor possible, as in its natural condition it was entirely unsuited to the needs of navigation. Improved conditions on the Great Lakes, of which the improvement of Fairport Harbor is a part, have resulted in a very great reduction in water rates. Water rates on the bulk commodities, iron ore and coal, which comprise about 84 per cent of the total commerce of the harbor, have been reduced below possible rail competition. Rail rates on other commodities have been affected to an indeterminate extent by the improvement.

Proposed operations.—It is expected that available funds will be exhausted about June 30, 1917, and an estimate of \$12,000 is submitted for necessary work of maintenance in the fiscal year 1918.

Commercial statistics.—Of the tonnage of the port 84 per cent is iron ore and coal handled in vessels with a draft of 19 to 20 feet. The remaining 16 per cent of the commerce is miscellaneous in character, including considerable quantities of grain, limestone, and packet freight.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	3,156,842	\$21,277,106
1914.....	2,454,304	12,816,270
1915.....	3,309,485	26,118,618

Amount expended on all projects from Mar. 3, 1825, to June 30.

1916:	
New work	\$977,162.18
Maintenance (since 1903)	149,454.18
Total	1,126,616.36
July 1, 1916, balance available	6,159.78
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	12,000.00

ASHTABULA HARBOR, OHIO.

Location and description.—Ashtabula Harbor is located at the mouth of the Ashtabula River, which flows into Lake Erie 61 miles easterly from Cleveland, Ohio. It comprises the lower 1¾ miles of the river and about 1 mile of the lake front at its mouth, protected by breakwaters, which form an outer harbor about 100 acres in area.

Condition at the end of fiscal year.—Under the earlier projects the river mouth was improved by dredging and the construction of parallel jetties, which resulted in obtaining and maintaining a channel 20 feet deep at mean lake level. The jetties have since been abandoned to private interests by whom they have been replaced with bulkheads so located as to afford a wider channel. Under the existing project, as first adopted, a west breakwater 3,380 feet long and an east breakwater 1,200 feet long were built, affording an outer harbor of limited area.

Under the provisions of the river and harbor act of June 25, 1910, the west breakwater was extended shoreward and lakeward to an aggregate length of 6,600 feet; a new outer east breakwater 4,500 feet in length was built; the east and west breakwaters were terminated with pierheads at their outer ends; and the outer 600 feet of the old east breakwater was removed. Breakwaters and pierheads were completed in 1915.

At the end of the fiscal year the harbor works were in good condition, except the timber section of the west breakwater, the superstructure of which was decayed to such an extent that it requires rebuilding. A depth of 21 feet at mean lake level was available in the harbor.

The project adopted in 1896, and modified in 1910, was completed at a cost approximately \$518,000 less than the estimates. Of the total amount expended, approximately \$215,000 was applied to work on the west breakwater authorized by the river and harbor act of March 3, 1905, the cost of which was not estimated in advance and consequently is not included in the estimate of cost as stated under "Existing project."

Expenditures under the existing project to the end of the fiscal year were \$1,717,233.58, of which \$1,658,394.16 was for new work and \$58,839.42 was for maintenance since 1903, prior to which time the amounts expended for works of improvement and for maintenance were so involved that it is impracticable to separate them.

Local cooperation.—None directly provided by law. The city of Ashtabula expended about \$268,000 in widening and deepening the channel and constructing bulkheads for a distance of about one-half mile at the upper limit of the navigable portion of the river. This channel is 150 feet wide and 18 feet deep at mean lake level. The maintenance of the channel in the river below this portion has been carried on by railroads and other private interests, but it is impracticable to state the amount expended for this purpose.

In 1902 and 1906 the Secretary of War under authority of law authorized the Pennsylvania Railroad Co. and the Lake Shore & Michigan Southern Railway Co. (now the New York Central Railroad Co.) to take possession of the west and east jetties, respectively. The railroad companies subsequently removed both jetties and replaced them with bulkheads so arranged as to increase the channel width to about 300 feet. The railroad companies also improved the lake front by filling and the construction of slips. The Lake Shore & Michigan Southern Railway Co. under authority of the Secretary of War extended the old east breakwater along the dock front a distance of 1,200 feet. This improvement, which cost about \$116,000,

was intended primarily as a protection to the railroad docks, but was, nevertheless, beneficial to the general interests of navigation.

Effect of improvement.—The improvement has made the commercial development of Ashtabula Harbor possible, as in its natural condition it was entirely unsuited to the needs of navigation. Improved conditions on the Great Lakes, of which the improvement of Ashtabula Harbor is a part, have resulted in a very great reduction of water rates. Water rates on the bulk commodities iron ore and coal, which comprise almost the entire commerce of the harbor, have been reduced below possible rail competition and rail rates have therefore not been affected by the improvement.

Proposed operations.—(a) The available balance will be expended as follows:

Part maintenance of district office and inspection boat.....	\$2, 000
Operation and maintenance of U. S. dredges <i>Burton</i> and <i>Maumee</i> , one-half month each.....	3, 700
Repair superstructure of about 430 linear feet timber portion of west breakwater by contract or with Government plant and hired labor....	19, 100
Total	24, 800

It is estimated that available funds will be exhausted about May 30, 1917.

(b) It is probable that some dredging will be needed in the westerly portion of the outer harbor, as shoals are constantly forming. It is estimated that an additional appropriation of \$15,000 will be needed for maintenance for the fiscal year ending June 30, 1918, to be expended as follows:

Part maintenance of district office and inspection boat.....	\$2, 000
Operation and maintenance of U. S. dredge <i>Maumee</i> 2 months.....	6, 000
Part cost of new district inspection boat and dump scow.....	7, 000
Total	15, 000

Commercial statistics.—All vessels trading at Ashtabula Harbor make use of the improvement. Practically the entire commerce of the port is the transshipment of iron ore and coal in vessels with a draft of 19 to 20 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	15, 743, 375	\$45, 952, 628
1914.....	11, 833, 302	29, 529, 689
1915.....	14, 521, 729	45, 119, 231

Amount expended on all projects from May 20, 1826, to June 30, 1916:

New work.....	\$2, 223, 586. 43
Maintenance (since 1903).....	58, 839. 42
Total.....	2, 282, 425. 85
July 1, 1916, balance available.....	24, 870. 01
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	15, 000. 00

ASHTABULA HARBOR, OHIO—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 997, Sixty-fourth Congress, first session.

Ashtabula Harbor is situated at the mouth of Ashtabula River, 61 miles by water east of Cleveland, Ohio. The existing project provides for an outer harbor of about 100 acres, protected by breakwaters of a total length of about 11,000 feet; for the removal of about 600 feet of the outer end of the old east inner breakwater, and for maintenance of an outer harbor area to a depth of 21 feet below mean lake level. All work authorized under the existing project, with the exception of maintenance, has been completed. The enlargement of the outer harbor in recent years has resulted in centering the commerce at the lake front and connecting slips, instead of developing the inner harbor along the river. To allow for variations of water level and to provide adequate facilities for maneuvering and anchorage of large lake vessels, the district officer believes that it is advisable to dredge to a depth of 22 feet at mean lake level, or 20 feet at low water, over the area indicated on the accompanying map and to extend the west breakwater to the shore in order to prevent the further erosion of the shore line and the movement of material into the harbor, all at an estimated cost of \$83,000; provided that dredging in west basin north of the Pennsylvania Railroad Co.'s pier be delayed until the shore line is protected by a solid bulkhead. The division engineer concurs in this opinion, subject to the further condition that no dredging be done within the harbor line established June 21, 1907.

The Board of Engineers for Rivers and Harbors believes that it is advisable to undertake the proposed improvements substantially as estimated, but it recommends, however, that the United States do no dredging in the channels south of the west basin, or south of the line ABCD on the accompanying map.

I concur generally in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of Ashtabula Harbor, Ohio, is deemed advisable to the extent of extending the west breakwater to the shore, and dredging to a depth of 22 feet at mean lake level, or 20 feet at low water, the area indicated on the accompanying map, not extending, however, south of the line ABCD, at an estimated cost of \$83,000; provided that dredging in west basin north of the Pennsylvania Railroad Co.'s pier be delayed until the shore line is protected by a solid bulkhead. The proposed improvement will not materially affect the cost of maintaining the harbor, which is now estimated at \$5,000 per annum.

CONNEAUT HARBOR, OHIO—MODIFIED PROJECT.

Report of the Chief of Engineers, printed in House Document 983, Sixty-fourth Congress, first session:

2. Conneaut Harbor is situated at the mouth of Conneaut River, 74 miles by water east of Cleveland, Ohio. The present project, adopted by the act of June 25, 1910, provides for largely increasing the outer harbor area by extending the east breakwater 800 feet toward shore and 900 feet into the lake, terminating in a pierhead, providing a main harbor entrance 600 feet wide; constructing a new outer west breakwater, with pierhead extending west 1,000 feet, and 3,700 feet toward shore; removing 600 feet of the outer end of the old inner west breakwater and 500 feet of the outer end of the east inner pier; and dredging in the outer harbor to a depth of 21 feet at mean lake level, all at an estimated cost of \$1,338,681. The largest lake vessels use this harbor and the usual draft is between 19 and 21 feet. In view of the occasional depression of the lake level due to seasonal changes and the action of winds, the district officer reports that the depths provided by the project are insufficient, and he believes that a depth of 20 feet at low water or 22 feet at mean lake level should be provided in that portion of the outer harbor used by large vessels and in the channel between the inner piers. In order to better protect the city front and afford opportunity for future development he believes that it is advisable to make a slight change in the direction of that portion of the west breakwater still remaining to be built, and he also believes that

it is advisable to remove all of the old west breakwater, which obstructs the use of the outer harbor. The cost of these additions to the project is estimated at \$64,835, but it is proposed to omit from the project the removal of the outer portion of the east pier and the dredging of the area east of this portion, estimated to cost \$28,745, making the net additional cost of the project now recommended \$36,090. The division engineer and the Board of Engineers for Rivers and Harbors concur in the views and recommendations of the district officer.

3. After due consideration of the above-mentioned reports I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore recommend legislation authorizing the modification of the project for improvement of Conneaut Harbor, Ohio, so as to provide for a depth of 20 feet at low water (22 feet at mean lake level) in the channel between the piers and in the outer harbor between the outer breakwaters and the limiting lines shown on accompanying map; for removal of remaining portion of old west breakwater, and for changing alignment of the unconstructed portion of the new west breakwater, omitting the provision for removal of outer 500 feet of the east pier and for dredging the area "M" shown on the map. Funds now on hand are believed to be sufficient to complete the project with the changes proposed.

CONSTRUCTION OF LOCKS AND DAMS ON THE OHIO RIVER.

For the actual construction of the new locks and dams and the operation and care of the completed structures the river is divided into four sections under the immediate supervision and direction of the district engineer officers at Pittsburgh, Wheeling, Cincinnati (first district), and Louisville. The execution of surveys, preparation of plans for the locks and dams, and other matters pertaining to the slack-water improvement of the Ohio River as a whole are carefully considered by a special board consisting of these district officers and the division engineer.

The Pittsburgh section extends from the head of the river at Pittsburgh, Pa., to Steubenville, Ohio, a distance of 65.7 miles, and includes Dams Nos. 1 to 10; the Wheeling section extends from Steubenville, Ohio, to a point 2 miles below Huntington, W. Va., a distance of 245.2 miles, and includes Dams Nos. 11 to 28; the Cincinnati section extends from a point 2 miles below Huntington, W. Va., to a point 2 miles above Madison, Ind., a distance of 242.7 miles, and includes Dams Nos. 29 to 40; the Louisville section extends from a point 50 miles above Louisville and 2 miles above Madison, Ind., to Mound City, Ill., a distance of 408 miles, and includes Dams Nos. 41 (with the Louisville & Portland Canal) to 54.

Location and description.—The Ohio River is formed by the junction of the Allegheny and Monongahela Rivers at Pittsburgh, Pa. It flows in a general southwesterly direction and empties into the Mississippi River at Cairo, Ill. The total length of the river is 968.5 miles.

The existing project was adopted by the river and harbor act of June 25, 1910. It contemplates the improvement of the entire Ohio River by the construction of locks and movable dams, so as to provide a minimum channel depth of 9 feet in the pools formed thereby, and widening of Louisville & Portland Canal in accordance with the report submitted in House Document No. 492, Sixtieth Congress, first session, or such modification thereof as in the discretion of the Secretary of War may be advisable, and with a view to the completion of such improvements within a period of 12 years.

The report upon which the project is based gives the original estimate, made in 1906, for work of construction as \$63,731,488, in addition to appropriations previously made. The annual cost of maintenance is estimated in said report at \$810,000, this amount covering the salaries of the lock forces and the cost of repairs and renewals. Additional information concerning the project, including a discussion of details of construction, is given in House Document No. 1159, Sixty-second Congress, third session. The last-named document contains a map of the river and its principal tributaries, on which is indicated the proposed location of the various dams. The total number of locks and dams proposed by the adopted project, including those authorized under previous projects (Nos. 1, 2, 3, 4, 5, 6, 8, 11, 13, 18, 19, 26, and 37), was 54.

A modification of the adopted project to provide increase in the minimum width of the Louisville & Portland Canal from 170 to 200 feet, and also for increasing the width of the proposed new lock at No. 41 from 85 to 110 feet, so as to give it the same dimensions as other Ohio River locks, was approved by the Secretary of War March 24, 1911. Dam No. 41 at Louisville is at the upper end of the Louisville & Portland Canal, the lock being at the lower end. This canal is 2 miles long and provides passage around the Falls of the Ohio.

A further modification of the project, omitting Lock and Dam No. 42, by adjusting the lifts of Dams Nos. 43, 44, 45, and 46, was approved by the Secretary of War on September 12, 1913, thus reducing to 53 the total number of locks and dams in the approved project.

Effect of improvement.—The work of canalization of the Ohio River is not sufficiently advanced to have any appreciable effect on freight rates, but the probable results of the improvement are discussed at some length in House Document No. 492, Sixtieth Congress, first session. The great future benefit of the improvement will be felt only when the slack-water system has been extended far enough downstream to permit of continuous navigation at all times (except when interfered with by floods or ice) over a longer section of the river. It should be noted, however, that the large manufacturing concerns state that the certainty of coal delivery by water is a much greater advantage than the actual saving in cost, which has heretofore been computed as varying from 30 to 50 cents per ton in favor of water transportation.

Proposed operations.—The funds which are available at the end of the year from previous appropriations will be variously applied at each of the locks and dams now under construction and still unfinished, to that part of the work the early completion of which will be most advantageous to the progress of the particular work. Upon those locks and dams which are nearest completion they will be applied to the placing of the wickets with their different parts, installing gate-operating machinery or power-house equipment, and in placing in proper condition the grounds belonging to the improvement. Where work has not been so far advanced the available funds will be applied to cofferdam construction and in placing the masonry of lock and dam, depending on the state of the particular work, or in paying contractors for such works as are in progress under contract. It is not possible to state definitely the rate at which funds at present available will be expended as the rate of progress is controlled largely by river conditions. It may be added, however, that

should river conditions be at all favorable it is expected that funds available July 1, 1916, will last only a few weeks at some localities and will be exhausted at all places before the close of the present working season.

The funds appropriated by the river and harbor act of July 27, 1916, for continuing work of canalization of the Ohio River will be applied toward carrying forward or completing those locks and dams now in process of construction and for constructing under contract the locks only at Nos. 23, 25, and 27, for which latter purpose it is estimated approximately \$2,000,000 will be required.

It is proposed to apply the funds (\$5,000,000), for which estimate is made in this report to continuing or completing work upon funds available July 1, 1916, or those appropriated by the river and harbor act of July 27, 1916, will not be sufficient, to commencing the construction of the dams at Nos. 23, 25, and 27, as well as commencing the construction of such additional locks and dams in serial order downstream as may be possible with funds available.

Commercial statistics.—About 57 per cent of the tonnage for the calendar year 1915 was coal and the remainder miscellaneous freight.

Comparative statement.

	Short tons.	Value.	Passen- gers.
Calendar year 1913:			
Through locks and open river.....	8,412,603.8	\$40,940,511.71	1,320,952
Ferries.....	1,401,519.5	36,086,390.07	2,949,834
Total.....	9,814,123.3	77,026,901.78	4,270,786
Calendar year 1914:			
Through locks and open river.....	7,589,161.5	38,068,685.74	1,307,728
Ferries.....	1,941,148.0	55,225,794.14	2,648,183
Total.....	9,530,309.5	93,294,479.88	3,955,911
Calendar year 1915:			
Through locks and open river.....	7,346,357.8	50,906,170.52	1,919,351
Ferries.....	1,926,826.5	137,604,744.20	3,098,024
Total.....	9,273,184.3	188,510,914.72	5,017,375

Amount expended on all projects from Mar. 3, 1875, to June 30, 1916, new work.....	\$39,603,695.25
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Balance available for fiscal year ending June 30, 1917.....	5,801,115.54
Amount (estimated) required to be appropriated for completion of existing project.....	33,265,488.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement.....	5,000,000.00

HARBOR AT ONTONAGON, MICH.

Location and description.—The harbor is situated on the south shore of Lake Superior, 138 miles east of Duluth and 274 miles west of Sault Ste. Marie. It consists of the improvement of the mouth of Ontonagon River.

Existing project.—The existing project provides for a channel 150 feet wide, 17 feet deep through the bar in the lake, 100 feet wide and 15 feet deep between the entrance piers, and two short channels 75

feet wide and 15 feet deep leading from the inner end of the Government piers to the nearest end of the principal wharves on each side of the river, all at an estimated cost of \$15,400 for improvement and \$9,000 annually for maintenance. (H. Doc. No. 602, 61st Cong., 2d sess., which contains the latest published map.) It was adopted by the river and harbor act of June 25, 1910. The plane of reference is low-water datum, which is 601.75 feet above mean tide at New York.

Conditions at the end of fiscal year.—The channels provided for in the present project were completed with the exception of about 75 feet of the south end leading to the wharf on the east side of the river. They have been maintained by dredging. The project is about 98 per cent completed. The depth has been increased from 8 to 15 feet. Serious shoaling between the piers and on the bar in the lake approach occurred this spring. A contract has been let and a dredge is now at work removing the shoals. A maximum draft of 11 feet can now be carried to the lumber wharf on the east side of the river. The short channel to the wharf on the west side of the river has an available depth of only 6 feet and will not be dredged this season, as no shipping will be done from it. The total expenditure under the present project is \$59,349.74, of which \$4,260 was for improvement and \$55,089.74 for maintenance.

Effect of improvement.—All classes of vessels using this harbor are dependent on the Government improvements. About 94.5 per cent of the vessels engaged in business at this harbor in 1915, and carrying 28 per cent of the total amount of freight moved, required a draft of from 6 to 10 feet. The balance (about 5.5 per cent) carrying 72 per cent of the total freight, required a draft of 12 to 14 feet.

Proposed operations.—The available balance of \$10,225.26 will be expended for maintenance in repairs to piers, dredging to remove shoals, operation of United States floating plant, and administration and contingencies as follows:

Dredging to remove shoals: Operation of U. S. dredge <i>Gaillard</i> , tug, and scows, in part.....	\$6, 500. 00
Repairs to piers:	
Operation of United States derrick, scow, and tug, in part.....	700. 00
Purchase of materials, timber, iron fastenings, rock, etc.....	800. 00
Administration and contingencies.....	2, 225. 26
Total	10, 225. 26

The funds will be exhausted early in the season of 1917.

Deposits from the river during freshets fill up the channels, which necessitates dredging annually. Because of the necessity for dredging, and of small appropriations for a number of years, the piers have been neglected and are now in a bad state of decay, requiring extensive repairs to the superstructures. It is proposed to make these repairs as fast as possible. It is estimated that \$9,000, in addition to the funds now available, will be required for maintenance during the fiscal year 1918.

This work is all for maintenance, and will be done by Government plant, as follows:

Operation of U. S. dredge <i>Gaillard</i> , tug, and scows, in part.....	\$4, 500
Operation of U. S. derrick scow No. 7, and tug, in part.....	1, 500
Purchase of materials, timber, iron fastenings, and rock.....	2, 000
Administration and contingencies.....	1, 000
Total	9, 000

Commercial statistics.—Receipts consisted principally of machinery and fish; shipments consisted principally of machinery and lumber.

Comparative statement.

Calendar years.	Short tons.	Value.
1913.....	8,525	\$120,609
1914.....	12,032	162,851
1915.....	4,697	395,748

Amount expended on all projects from Mar. 2, 1867, to June 30, 1916:	
New work.....	\$289,061.24
Maintenance	168,416.50
Total	457,477.74
Balance available for fiscal year ending June 30. 1917.....	10,225.26
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	9,000.00

HARBOR OF REFUGE AT GRAND MARAIS, MICH.

Location and description.—The harbor is situated on the south shore of Lake Superior 313 miles east of Duluth, Minn., and 90 miles west of Sault Ste. Marie, Mich. It is a natural deep-water bay, having a length of 2 miles, width of three-eighths mile, an area of 240 acres, and a depth of 18 to 57 feet.

Existing project.—The existing project was adopted by river and harbor act of June 14, 1880, pursuant to which plans were approved by the Secretary of War August 5, 1881. (Annual Report for 1881, p. 2050.) It provides for the construction of parallel timber-crib piers 500 feet apart—aggregate length 3,450 feet—extending out to a depth in the lake of 22 feet at ordinary low water (which is 601.75 feet above mean tide at New York, or 0.5 foot below mean lake level, 1860–1875), and dredging a channel between the piers at the low-water datum 300 feet wide and 18 feet deep at the harbor end, and 500 feet wide and 20 feet deep at the lake end, all at an estimated cost of \$450,000. No estimate for maintenance. The project was extended in 1894 to provide for closing the natural entrance, 5,770 feet wide, by a pile dike at an estimated cost of \$34,000, making a total estimated cost of the entire project of \$484,000. (Latest published map, Annual Report for 1903, p. 1826.)

Condition at end of the fiscal year.—Parallel piers were built 500 feet apart, 1,912 and 1,545 feet long, respectively, including a pile revetment 100 feet long at the inner end of each pier; a channel 250 feet wide and 18 feet deep dredged between the piers from the lake to the bay; and a pile dike built in 1895–1897 to close the natural entrance, which was 5,770 feet in width. Except for some shoaling along the east side the channel between the piers is maintained to about the project depth by the scour of the currents, but shifting sand moving along the shore from the west forms a bar about 300 feet wide across the lake approach of the entrance which requires dredging annually. The project is about 85 per cent completed. There remains to be constructed 193 linear feet of crib piers not now required and dredg-

ing to widen the inner portion of the channel, now 250 feet wide, to the project width of 300 feet.

A maximum draft of only 15 feet can be carried through the channel because of a bar which has formed in front of the entrance. This will be removed during the present season. The total expenditure of the modified project up to the end of the fiscal year, not including outstanding liabilities, is \$355,885.29 for improvement and \$207,391.66 for maintenance, a total of \$563,276.95.

Effect of improvement.—No rail connection exists. This harbor is primarily a harbor of refuge and as such has been of unquestioned benefit to commerce. Without the aid afforded by Government improvements this harbor would be inaccessible to vessels drawing more than 7 feet. During the navigation season of 1915, 80 per cent of the vessels making use of this harbor, and representing 12.64 per cent of the total registered tonnage, with a draft of 6 to 8 feet, carried all of the freight received at and shipped from the harbor. The balance of the vessels (20 per cent in number, and 87.36 per cent of the registered tonnage), requiring a draft of 12 to 20 feet, entered this harbor for shelter.

Proposed operations.—Operations for the fiscal year ending June 30, 1918, will consist of dredging to maintain the entrance channel and such minor repairs to piers as are necessary. A bar which forms in the lake in front of the entrance requires dredging annually of late years, and the piers need minor repairs where damaged by ice and ordinary decay. The available balance of \$12,458.69 will be expended for maintenance, as follows:

Dredging to remove shoals: Operation of U. S. dredge <i>Gaillard</i> , tug, and scows, in part.....	\$8, 000. 00
Repairs to piers:	
Operation of United States derrick scow and tug, in part.....	1, 200. 00
Purchase of materials, etc.....	800. 00
Administration and contingencies.....	2, 458. 16
Total.....	12, 458. 16

The dredging will be done in the working season of 1916. The funds will be exhausted early in the season of 1917.

Additional funds will be required for maintenance in removing shoals and repairs to piers during the fiscal year ending June 30, 1918, and the following estimate is submitted:

Operation of U. S. dredge <i>Gaillard</i> , tug, and scows, in part.....	\$6, 000
Operation of U. S. derrick scow <i>No. 7</i> and tug, in part.....	1, 000
Purchase of materials, timber, rock and iron fastenings.....	1, 000
Administration and contingencies.....	2, 000
Amount to be appropriated.....	10, 000

Commercial statistics.—Receipts consist principally of miscellaneous merchandise and fish; shipments consist of fish.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	330	\$49, 084
1914.....	656	98, 600
1915.....	710	115, 700

Amount expended on all projects from June 14, 1880, to June 30, 1916:

New work-----	\$355, 885. 29
Maintenance -----	207, 391. 66
Total-----	<u>563, 276. 95</u>
Balance available for fiscal year ending June 30, 1917-----	12, 458. 69
Amount (estimated) required to be appropriated for completion of existing project-----	45, 401. 68
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	10, 000. 00

ST. JOSEPH HARBOR AND RIVER, MICH.

(A) ST. JOSEPH HARBOR, MICH.

Location and description.—This harbor is located on the east shore of Lake Michigan, about 60 miles from Chicago. The harbor is formed by the lower part of the St. Joseph River, and extends from Lake Michigan along the city front of St. Joseph to the Benton Harbor Canal and thence along the canal to Benton Harbor. The river enters Lake Michigan through a channel protected by piers and revetments.

Existing project.—The existing project provides for the extension of the north pier 1,000 feet to the 20-foot contour, and the south pier, parallel to the north pier, 1,800 feet to the 18-foot contour; for dredging the entrance to the harbor and a space 150 feet wide along the city front of St. Joseph to a depth of 18 feet, and the Benton Harbor Canal and a turning basin at the mouth of St. Joseph River to a depth of 15 feet; all at an estimated cost of \$380,000 and \$10,000 annually for maintenance. The project depths are referred to low water, which is 2 feet below mean lake level 1860–1875. This project was adopted by the river and harbor act approved March 3, 1899, as per House Document No. 307, Fifty-fifth Congress, second session, which contains the latest published complete map. The complete plan of improvement includes the maintenance of the piers and revetments built under previous projects. The width between piers is 325 feet at the entrance narrowing to 250 feet.

Condition at the end of fiscal year.—The pier construction provided for by the project was completed in the fiscal year 1904, the piers and revetments having lengths, respectively, of 2,854 feet on the north side and 2,603 feet on the south side. Dredging in the fiscal year 1907 completed the project depths. The total length of channel from the entrance to the inner end of the Benton Harbor Canal is about 2.1 miles. The condition of the piers and revetments is good, with the exception of the inner portions, which need rebuilding. The controlling depths below low water at the end of the fiscal year were 18 feet between the piers, about 17 feet thence to the mouth of the Benton Harbor Canal, and 14 feet in the canal. The total amount expended under the existing project to June 30, 1916, was \$429,832.30, of which \$303,093.38 was for new work and \$126,738.92 for maintenance. Annual dredging is required for maintenance.

Local cooperation.—There were no requirements as to local cooperation. The construction of the revetments and wharves of the interior channel and a portion of the Benton Harbor Canal was at the expense of the local interests.

Effect of improvement.—The freight rates by vessels to Chicago are about 10 per cent less than the corresponding railroad rates. The principal benefit to commerce is better facilities for shipping manufactured and agricultural products and for carrying passengers, especially in the summer-resort season.

Proposed operations.—The funds for maintenance were exhausted June 30, 1916. The river and harbor act approved July 27, 1916, provided \$36,500 for maintenance, which will be used for repair of the north revetment, maintenance dredging, incidental repairs, surveys and superintendence, and contingencies, and will be exhausted by the end of the calendar year 1917.

Annual dredging is required to restore full project depths and maintain them and the harbor structures require repairs and renewals. The inner portion of the south revetment is in need of almost complete rebuilding above and below the water line, and the decking on part of the piers is in bad repair, all on account of decay due to age. The following estimate for maintenance is submitted for the fiscal year ending June 30, 1918:

Repair of 819 feet of south revetment.....	\$30, 000
Repairs to decking on piers and minor dredging.....	1, 500
Survey and inspection steamer <i>Hancock</i>	800
Annual survey, superintendence and contingencies.....	700
Total.....	33, 000

Commercial statistics.—The commerce for 1915 was 41 per cent crushed stone and sand, 33 per cent fruit and vegetables, and the balance was largely miscellaneous merchandise, vinegar, and pickles, and paper. There was a decrease in receipts of crushed stone and an increase in shipments of fruit and vegetables, and of sand.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	84,795	\$5,232,285
1914.....	99,550	6,209,910
1915.....	104,192	4,975,736

Amount expended on all projects from July 4, 1836, to June 30, 1916:

New work.....	\$806,206.61
Maintenance.....	126,738.92
Total.....	932,945.53

Balance available for fiscal year ending June 30, 1917..... 36,500.00

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 33,000.00

(B) ST. JOSEPH RIVER, MICH.

Location and description.—St. Joseph River rises in Michigan, flows southwestward into Indiana, thence northwest, and empties into Lake Michigan at St. Joseph.

Existing project.—The project provides for securing a depth of 2 to 3 feet at low water from St. Joseph to Berrien Springs, a distance of about 22 miles, by building wing dams, making cuts through the shoals, and removing snags, at a cost of \$11,300. The project was adopted by the river and harbor act approved August 11, 1888. (Annual Report for 1880, pp. 2049–2055.) There is no adopted estimate for annual maintenance. There is no published map.

Condition at the end of fiscal year.—Some of the worst places had been improved in a temporary way from year to year so that steamboats with draft of 3 feet or less operated between St. Joseph and Berrien Springs up to 1908; since 1908 little use of the river has been made, and this use has been confined to the lower 7 miles for gasoline boats of about 26 inches draft. The available depths at usual summer stage are about 3 feet in the lower 9 miles and 2 to 2.5 feet in the remaining portion to Berrien Springs. The total amount expended under the existing project to June 30, 1916, was \$8,606.39, of which \$4,555.49 was for new work and \$4,050.90 for maintenance.

Effect of improvement.—Prior to the building of electric railway lines on both sides of the river and prior to the purchase of the river steamboats by one of these lines, in 1908, the improvement was of benefit, in a very limited way, for transportation of farm products. At present, even if completed as originally planned, it would be of little benefit to commerce.

Proposed operations.—The funds available for maintenance will be reserved for surveys or examinations when required. Logging and snagging operations with dredging are necessary every few years to keep open the river channel. The following estimate is therefore submitted for the fiscal year ending June 30, 1918:

Maintenance by logging, snagging, and dredging----- \$1,000

Commercial statistics.—The only commerce in 1915 was on the lower 6 miles of the river, where one gasoline boat made 250 round trips, carrying passengers and campers' outfits and supplies. Some sand and gravel was dredged from this portion of the river for commercial use. The commerce for 1913 and 1914 was similar to that for 1915.

Amount expended on all projects from August 11, 1888, to June 30, 1916:

New work -----	\$4, 555. 49
Maintenance -----	4, 050. 90
Total-----	<u>8, 606. 39</u>

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----

1, 000. 00

SOUTH HAVEN HARBOR, MICH.

Location and description.—This harbor is located on the east shore of Lake Michigan, about 77 miles from Chicago, and consists of the lower part of Black River, which flows into the lake through a channel protected by revetments and piers. The city of South Haven is situated on both banks of the river.

Existing project.—The existing project provides for the establishment of dock lines 200 feet apart along the river, the building of

bulkheads along these lines by riparian owners, and deeding the property on the channel side of the dock lines to the Government free of cost; for repairs to piers and revetments to permit of the deeper dredging; for extension of each pier 800 feet, increasing the entrance width from 170 to 200 feet; for dredging between the piers for a width of 120 feet and depth of 19 feet, and above them for a width of 90 feet and depth of 17 feet; with a winding basin at the inner end 300 feet wide; all at an estimated cost of \$279,370, and not less than \$10,000 annually for maintenance. Depths are referred to low water (2 feet below mean lake level, 1860-1875). This project was adopted by river and harbor act approved March 3, 1905. (H. Doc. No. 119, 58th Cong., 2d sess., which contains latest published map.) Present width between piers is 190 feet at entrance, narrowing to 166 feet. This project is a complete plan, including works built under previous projects.

Condition at the end of fiscal year.—The entrance channel from Lake Michigan, with a width between piers of 190 feet at the entrance, narrowing to 166 feet inside, had been completed, with a north pier and revetment 2,143 feet in length, and a south pier and revetment 2,182 feet in length, and a depth of 16 feet at low water for a width of 120 feet between the piers, and the same depth with a width of 90 feet in the river to the highway bridge, a distance of about one-half mile. The project dredging was completed June 15, 1912. The total length of channel from the outer end of the piers to the highway bridge is 4,800 feet. The project had been completed, with the exception of 800 feet of pier work, 400 feet extension to each pier, and present operations are confined to maintenance. The condition of the piers and revetments is good, with the exception of portions of timber superstructure, which will require rebuilding in a few years. The controlling depth at the end of the fiscal year was the project depth of 16 feet. The total amount expended under the existing project to June 30, 1916, was \$254,124.65—\$162,018.74 for new work and \$92,105.91 for maintenance.

Local cooperation.—The entrance piers in Lake Michigan prior to 1866 were built by local interests at a cost of between \$18,000 and \$20,000. The construction of revetments and wharves along the river was by local interests. The river and harbor act approved March 3, 1905, required the establishment of dock lines and the building of bulkheads on these lines by the city or riparian owners and the donation of the property on the channel side of the dock lines to the United States. These requirements were complied with in 1910 at cost of \$35,000; 2,640 feet of revetment were built and the required land deeded to the United States in 1910.

Effect of improvement.—Vessel freight rates to and from Chicago are about 21 per cent less than the corresponding railroad rates. An important benefit to commerce is more direct communication with Chicago for the transportation of farm products and manufactured articles and for summer-resort business.

Proposed operations.—The funds for maintenance were exhausted June 30, 1916. The river and harbor act approved July 27, 1916, provided \$10,900 for maintenance, which will be used for dredging by U. S. dredge *Meade*, maintenance of existing works, and engineering and contingencies, and will be exhausted by June 30, 1917.

No estimate is submitted for completion of the project, as entrance depths are now maintained by dredging. Annual dredging is required for maintenance. The following estimate is submitted for the fiscal year ending June 30, 1918:

Operation and repair of dredge <i>Meade</i>	\$2, 000
Operation and repair of survey and inspection steamer <i>Hancock</i>	800
Engineering and contingencies.....	800
Total.....	3, 600

Commercial statistics.—The commerce for 1915 was 41 per cent fruit and vegetables, 31 per cent crushed stone, and the balance was largely miscellaneous merchandise.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	24, 563	\$1, 235, 501
1914.....	21, 489	2, 275, 881
1915.....	27, 435	1, 818, 645

Amount expended on all projects from March 2, 1867, to June 30, 1916:

New work	\$349, 251. 57
Maintenance	223, 345. 33
Total	572, 596. 90

Balance available for fiscal year ending June 30, 1917.....	10, 900. 00
Amount (estimated) required to be appropriated for completion of existing project.....	115, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	3, 600. 00

HOLLAND HARBOR, MICH.

Location and description.—This harbor is located on the east shore of Lake Michigan about 94 miles from Chicago, and consists of Black Lake, about 5 miles long, and thence a channel about one-half mile long between piers and revetments, extending into Lake Michigan.

Existing project.—The existing project adopted by river and harbor act of March 3, 1899 (H. Doc. No. 272, 54th Cong., 2d sess.), provided for dredging a channel from Black Lake to Lake Michigan, 16 feet deep below low water (2 feet below mean lake level 1860–1875), for repairs to piers and revetments and for extensions on existing alignments of about 800 feet to the north and 700 feet to the south pier at an estimated cost of \$240,000. The river and harbor act of March 3, 1905 (Annual Report 1905, p. 2176), widened the harbor entrance, providing for converging piers 300 feet apart at outer end, 740 feet apart at inner end, and connected at inner ends with existing piers. The river and harbor act of March 2, 1907, increased the estimated cost to \$273,052. There is no adopted estimate for annual maintenance. The latest published map is in House Document No. 817, Sixty-third Congress, second session. The complete project is for a channel 16 feet deep below low water from

Black Lake to Lake Michigan and maintenance of existing structures. The inside piers are 205 to 162 feet apart.

Condition at the end of fiscal year.—The project had been completed with a channel about one-half mile long and 16 feet deep below low water from Lake Michigan to Black Lake, protected by piers and revetments 2,845 feet long on the north side and 2,713 feet long on the south side; entrance width 300 feet, narrowing to 162 feet inside. The project dredging was completed in the fiscal year 1909 and the pier construction in the fiscal year 1910. Present operations are confined to maintenance. The condition of the piers and revetments is good. The project depth of 16 feet below low water is available from Lake Michigan to Black Lake. The total amount expended under the existing project to June 30, 1916, was \$471,532.47, of which \$315,007.99 was for new work and \$156,524.48 for maintenance.

Local cooperation.—There were no conditions imposed by law as to cooperation. Before 1868 the harbor commissioners of the town of Holland expended \$30,000 in cutting the new channel between Black Lake and Lake Michigan and in partly protecting its banks. In 1889 and 1890 the citizens of Holland contributed \$1,772 for dredging by Government dredge the entrance channel. In 1897 the Pere Marquette Railroad Co. constructed a revetment and dock about 850 feet long in extension of the inner end of the north revetment.

Effect of improvement.—Vessel freight rates to and from Chicago are about 11 per cent less than the corresponding railroad rates. The commerce is 53 per cent local and 47 per cent through. The principal benefit to commerce is increased facilities for shipping general merchandise and construction materials, and for summer-resort passenger business.

Proposed operations.—The funds for maintenance were exhausted June 30, 1916. The river and harbor act approved July 27, 1916, provided \$5,000 for maintenance, which will be used for dredging by U. S. dredge *Meade*, engineering and contingencies, and will be expended by June 30, 1917.

Annual dredging is required to maintain project depths, and the harbor structures require repairs and renewals from time to time. The following estimate is submitted for the fiscal year ending June 30, 1918:

Operation and repair of dredge <i>Meade</i>	\$6, 000
Operation and repair of survey and inspection steamer <i>Hancock</i>	800
Maintenance of existing works.....	2, 000
Engineering and contingencies.....	1, 200
Total.....	10, 000

Commercial statistics.—The character of the commerce for 1915 was 70 per cent general merchandise, 11 per cent sand and gravel, and 5 per cent fruit and vegetables.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	38,344	\$5,146,867
1914.....	34,074	4,352,237
1915.....	30,426	4,264,538

The usual limits of draft for loaded boats varies from 8 to 16 feet.

Amount expended on all projects from Aug. 30, 1852, to June 30, 1916:

New work-----	\$491, 627. 79
Maintenance -----	284, 121. 93
Total -----	775, 749. 77
Balance available for fiscal year ending June 30, 1917-----	5, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	10, 000. 00

GRAND HAVEN HARBOR, MICH.

Location and description.—This harbor is located on the east shore of Lake Michigan and consists of the lower mile or two of Grand River. It is about 107 miles from Chicago and 84 miles from Milwaukee.

Existing project.—The existing project provides for a channel at the mouth of Grand River, with an available depth of 18 feet from Lake Michigan (upper limit of improvement not stated), protected by piers and revetments, all at an estimated cost of \$804,366.15. There is no adopted estimate of cost of maintenance. The piers are 415 feet apart at the entrance, diminishing to 390 feet inside. The project was adopted by the river and harbor act of June 23, 1866, and amended by river and harbor acts of June 14, 1880; September 19, 1890; and June 13, 1892; which amendments consisted principally of changes in cost and length of piers and revetments. The latest published map is in the Annual Report for 1890, page 2650.

Condition at the end of fiscal year.—With the exception of 250 feet of pier extension, 150 feet to the north pier and 100 feet to the south pier, the project had been completed, with a channel about 1½ miles long from the end of the piers in Lake Michigan to the wharves in Grand Haven 18 feet deep below low water, with piers and revetments 3,538 feet long on the north side and 5,774 feet long on the south side; entrance width between piers 415 feet, narrowing to 390 feet inside. The project depth was completed in the fiscal year 1906. The piers and revetments are in good condition, with the exception of portions which are now under contract for repairs, or for which plans for repairs have been prepared. At the end of the fiscal year the project depth of 18 feet at low water was available. The amount expended on the project to June 30, 1916, was \$1,063,279.46, of which \$542,976.82 was for construction, and \$520,302.64 for maintenance.

Local cooperation.—There were no conditions imposed by law as to cooperation. Prior to the beginning of Government work the Detroit & Milwaukee Railroad Co. (now the Grand Trunk Railway) built a south pier and revetment 3,185 feet long. The revetments on the left bank of the river, above the inner end of the south Government revetment, were built by local interests.

Effect of improvement.—Vessel freight rates to and from Chicago are about 11 per cent lower than the corresponding railroad rates. The improvement is of benefit to interstate commerce, due to the operation between Grand Haven and Milwaukee of a line of car ferries and in connection therewith a line of bulk freight boats; 95 per cent is through traffic.

Proposed operations.—The funds on hand for maintenance will be expended by June 30, 1917, for uncompleted contracts and maintenance dredging, including office and engineering expenses.

No estimate is submitted for completion of the project, as entrance depths are now maintained by annual dredging. The river and harbor act approved July 27, 1916, provided \$71,750 for maintenance, which will be used for dredging by U. S. dredge *Meade*, repairs to north revetment, repairs to south pier superstructure, placing sheet piles in rear of south revetment, riprapping both piers, maintenance of existing works, and engineering and contingencies. The funds will be exhausted by the end of the calendar year 1917.

Annual dredging is required to restore full project depths, and the harbor structures require repairs and renewals from time to time. The following estimate for maintenance is submitted for the fiscal year ending June 30, 1918:

Operation and repair of U. S. dredge <i>Meade</i>	\$5, 000
Maintenance of existing works.....	800
Engineering and contingencies.....	750
Total.....	6, 550

Commercial statistics.—The commerce for 1915 consisted largely of grain and grain products, lumber, coal, and miscellaneous merchandise.

Comparative statement.

Calendar year.	Short tons. ¹	Value.
1913.....	649, 130	\$52, 791, 865
1914.....	645, 804	49, 331, 673
1915.....	663, 229	49, 489, 697

¹ Exclusive of weight of freight cars carried by car ferries.

Amount expended on all projects from June 23, 1866, to June 30, 1916:

New work.....	\$542, 976. 82
Maintenance	520, 302. 64

Total

1, 063, 279. 46

Balance available for fiscal year ending June 30, 1917.....	76, 780. 49
Amount (estimated) required to be appropriated for completion of existing project.....	40, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	6, 550. 00

MUSKEGON HARBOR, MICH.

Location and description.—This harbor is located on the east shore of Lake Michigan, about 113 miles from Chicago and 80 miles from Milwaukee, at the mouth of Muskegon River, which before emptying into Lake Michigan expands into Muskegon Lake, a body of water of navigable depth about 5 miles long.

Existing project.—The existing project provides for securing a channel about 5,600 feet long, protected by parallel piers and revetments, and extending from Lake Michigan to Muskegon Lake, with a depth of 20 feet at low water (2 feet below mean lake level), 1860–

1875) and a uniform width of 300 feet; for removing 1,040 feet of old pier and revetment; for extending the north pier 350 feet and the south pier 200 feet; for building 500 feet sheet-pile pier and 6,115 feet of sheet-pile revetment; for dredging 750,000 cubic yards; all at an estimated cost of \$380,000. This project was adopted by the river and harbor act of June 13, 1902. (H. Doc. No. 104, 56th Cong., 2d sess.) There is no adopted estimate for annual maintenance. The latest published map is in House Document No. 352, Sixty-third Congress, second session.

The complete plan of improvement includes also the maintenance of all existing Government piers and revetments.

Condition at the end of fiscal year.—The channel from Lake Michigan to Muskegon Lake, with a width between piers of 308 feet at the entrance and 300 feet farther inside, had been completed with a north pier and revetment 5,250 feet in length, and a south pier and revetment 4,710 feet in length; the project depth of 20 feet below low water was obtained in October, 1911. The project had been completed with the exception of 550 feet of pier extension, 350 feet to the north, and 200 feet to the south pier, which have been deferred, the entrance depths to be maintained by dredging. The piers and revetments are in good condition. The controlling depths below low water at the end of the fiscal year were 20.5 feet on the entrance bar in Lake Michigan and 18.5 feet in the channel between the piers. The total amount expended on the existing project to June 30, 1916, was \$370,568.42, of which \$225,189.54 was for new work and \$145,378.88 for maintenance.

Local cooperation.—The law adopted the present project in accordance with a report (H. Doc. No. 104, 56th Cong., 2d sess.) which provided "that the land to be removed in order to secure the increased width of channel and to build the revetments will be ceded without cost to the United States; also that an area equal to that at present occupied by the United States Life-Saving Service will be restored to the United States for the same occupation and purpose." The land required for widening the harbor was donated to the United States by deed of June 14, 1905. On the south side of the channel 650 feet of the revetment, in addition to that built by the United States, was built in 1897 by the Chicago & West Michigan Railroad Co. (now the Pere Marquette) for a car-ferry slip.

Effect of improvement.—Vessel freight rates to and from Chicago are about 11 per cent lower than the corresponding rates by railroad. The principal benefit to commerce is increased facilities for shipping manufactured articles, general merchandise, and road materials, the traffic being about 96 per cent local and 4 per cent through.

Proposed operations.—The funds available will be exhausted in July, 1916, for maintenance dredging by *Saginaw*.

No estimate is submitted for completion of the project, as entrance depths are maintained by annual dredging. Part of this dredging is more economically done by the *Meade* and part by the *Saginaw*. The river and harbor act approved July 27, 1916, provided \$7,500 for maintenance, which will be used for dredging by the U. S. dredges *Meade* and *Saginaw* and for minor repairs to structures, engineering, contingencies, and incidentals. The funds will be exhausted by June 30, 1917.

Annual dredging is required for maintenance, riprap is needed to protect both piers, which are endangered where the lake bottom or the riprap now in place is below the bottom of the cribs, repairs and renewals are required for the harbor structures from time to time. Surveys and inspections are necessarily frequent, due to shifting character of the bottom and sides of the channels, and the lake (all fine sand), and to the large amount of work on permits. The following estimate for maintenance is submitted for the fiscal year ending June 30, 1918:

Operation and repair of dredge <i>Meade</i>	\$7,500
Operation and repair of dredge <i>Saginaw</i>	3,400
Riprap for both piers, 5,100 tons.....	14,000
Maintenance of existing works.....	2,100
Operation and repair survey and inspection steamer <i>Hancock</i>	800
Engineering and contingencies.....	600
Total	28,400

Commercial statistics.—The commerce for 1915 was largely crushed stone and gravel, lumber (received), manufactured articles, and general merchandise; 82 per cent was receipts and 18 per cent shipments. Of the total commerce 42 per cent was receipts of crushed stone and gravel, and 24 per cent was receipts of lumber.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	110,773	\$7,819,964
1914.....	119,811	8,154,536
1915.....	115,035	8,244,279

Amount expended on all projects from Mar. 2, 1867, to June 30.

1916:

New work.....	\$613,407.96
Maintenance.....	283,453.82
Total.....	896,861.78

Amount (estimated) required to be appropriated for completion of existing project..... 66,000.00

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 28,400.00

WHITE LAKE HARBOR, MICH.

Location and description.—This harbor is located on the east shore of Lake Michigan, about 119 miles from Chicago. It consists of White Lake, a body of water about 4.5 miles long and of navigable depth, and of the channel leading to Lake Michigan.

Existing project.—The existing project provided for the abandonment of the old outlet and the creation of a new channel from Lake Michigan to White Lake, 200 feet wide between parallel piers and revetments, and of such depth between the piers and over the bar as will admit of the free use of the Government dredge *Meade* (formerly *Gillespie*), which use will require about 16 feet in still water. The project was adopted by the river and harbor act approved March

2, 1867, and amended by river and harbor acts approved March 3, 1873, July 5, 1884, July 13, 1892, and March 2, 1907. These amendments relate principally to the length of the proposed piers and revetments and the estimated costs, except the last one, which increased the project depth by dredging. The estimated cost is \$353,550. There is no adopted estimate for annual maintenance. The latest published map is in the Annual Report for 1884, page 1982.

Condition at the end of fiscal year.—A channel about 1,950 feet long had been constructed from Lake Michigan to White Lake, with a north pier and revetment 1,715 feet long, and a south pier and revetment 1,953 feet long, and with a width between piers of about 188 feet. To complete the project there is still required 50 feet extension to the north pier and 100 feet extension to the south pier. The project dredging was completed in the fiscal year 1908, but annual dredging is required to maintain the project depth. The outer portions of the piers are in fair condition, but the inner portions are dilapidated, due to decay. The controlling depths below low water at the end of the fiscal year were about 15 feet on the entrance bar in Lake Michigan and 14 feet in the channel between the piers. The total amounts expended under the existing project to June 30, 1916, was \$380,846.62, of which \$207,862.44 was for new work and \$172,984.18 for maintenance.

Effect of improvement.—Vessel freight rates to and from Chicago are about 11 per cent less than the corresponding railroad rates. The benefits to commerce are entirely local and centered chiefly in receipts of lumber and crushed stone and in the summer-resort business.

Proposed operations.—The small amount of available funds for maintenance will be reserved for surveys or emergencies. No estimate is submitted for the completion of the project, as entrance depths are maintained by annual dredging. The question of the abandonment or continuance of this harbor is the subject of a report now under consideration. It is proposed to make only absolutely necessary repairs of a minor nature to the piers and revetments until the question of the continued maintenance of this harbor is determined. If this harbor is to be maintained until June 30, 1918, the following amounts are necessary, principally for dredging to maintain project depths:

Operation and repair of dredge <i>Meade</i>	\$8, 000
Minor repairs to piers and revetments, engineering and supervision, surveys, etc.....	2, 000
Total.....	10, 000

Commercial statistics.—The commerce for 1915 was about 37 per cent crushed stone and gravel and 55 per cent lumber, all receipts.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	11, 078	\$263, 855
1914.....	10, 695	351, 260
1915.....	10, 071	335, 941

The usual limits of draft for loaded boats varies from about 8 to 16 feet.

Amount expended on all projects from March 2, 1867, to June 30, 1916:

New work -----	\$207, 862. 44
Maintenance -----	172, 984. 18
Total -----	<u>380, 846. 62</u>
July 1, 1916, balance unexpended -----	254. 68
Amount (estimated) required to be appropriated for completion of existing project -----	21, 720. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement -----	10, 000. 00

LUDINGTON HARBOR, MICH.

Location and description.—This harbor, located on the east shore of Lake Michigan, about 155 miles from Chicago, is the outlet of Pere Marquette River, which expands into Pere Marquette Lake before emptying into Lake Michigan. Pere Marquette Lake is about 2 miles long, one-half mile in average width, and from 20 to 40 feet deep.

Existing project.—The existing project, adopted by the river and harbor act of March 2, 1907, provides for a channel connecting Pere Marquette Lake with Lake Michigan, about 2,000 feet long, 183 to 285 feet wide, and 18 feet deep at low water (2 feet below mean lake level, 1860–1875), protected by piers and revetments; for an exterior basin in Lake Michigan formed by two breakwaters, each 1,800 feet long, 400 feet apart at the outer ends diverging at an angle of 90°, the inner ends to be connected with the shore by suitable structures; for the removal of the outward ends of the two inside piers; and mentioned as necessary the dredging of a considerable area in the exterior basin. The estimated cost of the project, exclusive of the dredging, was \$839,087, there being no approved estimate for maintenance. (H. Doc. No. 62, 59th Cong., 1st sess., and Rivers and Harbors Com. Doc. No. 3, 59th Cong., 2d sess.) The river and harbor act of July 25, 1912, increased the cost by \$51,500 for additional riprap and stone filling. The latest published map is in the Annual Report for 1914, page 2974.

The complete plan of improvement includes also the maintenance of the existing piers and revetments.

Condition at end of fiscal year.—The channel from Lake Michigan to Pere Marquette Lake had been completed with piers and revetments 2,040 feet long on the north side and 1,981 feet long on the south side, 250 feet wide at the outer end and 183 feet at the inner end. The two breakwaters, each 1,800 feet long, with entrance width of 400 feet and shore connections 1,100 feet long on the north side, and 2,000 feet long on the south side, had been completed, and the lakeward ends of the inside piers removed, completing the project. The distance from the entrance to the breakwaters to the entrance to the inside piers is 1,400 feet. The project depth is available. The breakwaters require additional riprap. 600 feet of the inner portion of the north revetment needs rebuilding, and the superstructure of other portions is in poor condition. The total amount expended un-

der the existing project to June 30, 1916, was \$986,334.52, of which \$924,322.78 was for new work and \$62,011.74 for maintenance.

Local cooperation.—There were no requirements as to local cooperation. The municipality has improved the water front to a small extent at the end of a street for public use. Land at the inner ends of the two breakwater shore connections was donated to the United States by local interests; that for the north shore connection, 160 feet by about 225 feet, by deed of June 22, 1912, and that for the south shore connection, about 200 feet square, by deeds of July 12, 1912, and November 12, 1912.

Effect of improvement.—The local freight rates by vessels to Chicago are about 16 per cent less than the corresponding rates by railroad. The principal benefit to commerce is the opportunity for trans-lake business, largely by car ferries. About 84 per cent of the commerce is through and 16 per cent local traffic.

Proposed operations.—There were no funds for new construction on hand June 30, 1916. The river and harbor act approved July 27, 1916, provided \$200,000 for new work, which will be used for dredging 280,000 cubic yards in the basin at a cost of \$50,000, and for 56,000 tons of riprap for the breakwater at a cost of \$150,000. (See Annual Report 1915, p. 1299.) The funds will probably be exhausted by June 30, 1918.

The available funds on hand for maintenance will be used for maintenance dredging, engineering and contingencies, and will be exhausted by October 1, 1916. The river and harbor act approved July 27, 1916, provided \$50,000 for maintenance, which will be used for rebuilding part of the north revetment, dredging by U. S. dredge *Meade*, maintenance of existing works, maintenance and operation of steamer *Hancock*, and engineering and contingencies. The funds for maintenance will be exhausted by the end of the calendar year 1917.

Annual dredging is required to maintain the project depth; minor repairs to breakwaters, piers, and revetments are required from time to time; and frequent surveys are required. The following estimate for maintenance is submitted for the fiscal year ending June 30, 1918:

Operation and repair of dredge <i>Meade</i>	\$4, 000
Maintenance of existing works.....	1, 200
Operation and repair of survey and inspection boat <i>Hancock</i>	800
Engineering and contingencies.....	1, 000
Total.....	7, 000

Commercial statistics.—The commerce for 1915 was largely grain and grain products, forest products, coal, salt, and miscellaneous merchandise; the increase over 1914 is due largely to an increase in coal, salt, grain and grain products, and lumber.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	1, 686, 864	\$61, 283, 391
1914.....	1, 510, 437	53, 408, 710
1915.....	1, 781, 329	57, 159, 037

The usual limits of draft for loaded boats varies from about 8 to 17 feet.

Amount expended on all projects from March 2, 1867, to June 30, 1916:

New work-----	\$1, 415, 739. 00
Maintenance -----	188, 463. 24
Total -----	<u>1, 604, 202. 24</u>
Balance available for fiscal year ending June 30, 1917-----	250, 805. 57
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	7, 000. 00

MANISTEE HARBOR, MICH.

Location and description.—This harbor is located on the east shore of Lake Michigan, about 180 miles from Chicago and 24 miles north of Ludington Harbor. It consists of Manistee Lake, about 4 miles by one-fourth to one-half mile, and 35 feet deep, and Manistee River, between Manistee Lake and Lake Michigan, about 9,300 feet long.

Existing project.—The existing project provides for an enlarged harbor entrance with a south breakwater 1,300 feet long and shore connection about 1,200 feet long; the removal of 450 feet of the lakeward end of south pier; the dredging of an entrance basin 570 feet wide and channel between the piers 120 to 220 feet wide, 20 feet deep; dredging the river with a minimum width of 90 feet from the inner end of the north pier to Manistee Lake 18 feet deep, the extension of the north pier 200 feet (if required); and the maintenance of the project; all at an estimated cost of \$456,000 and \$6,000 annually for maintenance, as adopted by river and harbor act of July 25, 1912. (H. Doc. No. 599, 62d Cong., 2d sess.) The project depths are referred to low water (2 feet below mean lake level 1860–1875). The complete project includes, also, the maintenance of the piers and revetments built under previous projects. The latest published complete map is in House Document No. 511, Fifty-ninth Congress, first session. The width between the piers is 195 feet at the entrance, narrowing to 166 feet.

Condition at the end of fiscal year.—The entrance channel from Lake Michigan, with a width between piers of 195 feet at the entrance, narrowing to 150 feet inside, had been completed, with a north pier and revetment 2,906 feet in length and a south pier and revetment 1,450 feet in length and a depth of 18 feet at low water between the piers; and a channel 16 feet deep at low water and 90 to 126 feet wide through the river from lake to lake. The breakwater had been constructed for a length of 700 feet, with 200 feet partly built and the remainder under contract, and the dredging in the interior channel under contract. The project was about 40 per cent completed. At the end of the fiscal year the available depths below low water were 18.5 feet between the piers and 14.5 feet in the river, with dredging in progress to increase these depths. The piers and revetments are in fair condition. The total amount expended under the existing project to June 30, 1916, was \$219,969.84, of which \$205,024.48 was for new work and \$14,945.36 for maintenance.

Local cooperation.—The project required the donation to the United States, without cost, of a strip of land 200 feet square at the

inner end of the shore connection of the breakwater. This provision was complied with April 10, 1913.

Effect of improvement.—Local freight rates by vessel to Chicago are about 16 per cent less than the corresponding rates by railroad. The principal benefit to commerce is improved facilities for the shipment from Manistee of forest products and salt.

Proposed operations.—The available funds will be spent by May 31, 1917, for the purchase of lumber for the shore arm of the breakwater and for superintendence and inspection, except sufficient funds to do about one-third of the dredging in the basin provided by the project. The total funds for the completion of this project were appropriated, but \$70,700 was withdrawn under the provisions of the river and harbor act of 1915. Of this, \$28,700 is now needed for the balance of the basin dredging, leaving \$42,000, to be provided later, for the extension of the north pier, if required. The following estimate is submitted for expenditures to June 30, 1918:

New construction: For completion of project dredging in basin.....	\$28, 700
For maintenance: Operation and repair of dredge <i>Meade</i>	6, 000

Total.....	34, 700
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Commercial statistics.—The commerce for 1915 was about 52 per cent salt and 26 per cent lumber shipments. The decrease from 1914 was largely in these two items of shipments.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	306, 898	\$3, 991, 589
1914.....	196, 322	3, 520, 595
1915.....	90, 842	1, 884, 157

The usual limits of draft for loaded boats varies from 8 to 16 feet.

Amount expended on all projects from Mar. 2, 1867, to June 30, 1916:

New work.....	\$560, 023. 16
Maintenance.....	165, 880. 22

Total	725, 903. 38
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July 1, 1916, balance available.....	41, 333. 51
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Amount (estimated) required to be appropriated for completion of existing project.....	70, 700. 00
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Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement.....	28, 700. 00
For maintenance of improvement.....	6, 000. 00

Total	34, 700. 00
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FRANKFORT HARBOR, MICH.

Location and description.—This harbor is located on the east shore of Lake Michigan, about 203 miles from Chicago. It is formed by Lake Betsie (Aux Becs Scies), about 1.5 miles long, generally shoal but with navigable depths in the westerly portion, and the artificial channel into Lake Michigan.

Existing project.—The existing project, as adopted by the river and harbor act of June 23, 1866, provided for a new outlet from Lake Aux Becs Scies to Lake Michigan, 750 feet south of the old outlet, to be 12 feet deep and 200 feet wide between parallel piers, at an estimated cost of \$146,400. By river and harbor act of July 13, 1892, the estimated cost was increased to \$325,659.85. The river and harbor act of June 3, 1896, provided for a “navigable depth of 18 feet.” The estimated cost of the entire project is \$421,938.35. There is no adopted estimate of cost of maintenance. As built, the piers are 218 feet apart at the entrance, narrowing to 195 feet inside. The latest published map is in House Document No. 1089, Sixty-fourth Congress, first session.

Condition at the end of fiscal year.—A new channel from Lake Michigan to Lake Betsie, about 2,000 feet long and 18 feet deep below low water, with a width at entrance of 218 feet, narrowing to 195 feet inside, had been constructed, with a north pier and revetment 2,000 feet long and a south pier and revetment 2,028 feet long. The project dredging was completed in September, 1903, and the pier construction in October, 1911. Present operations are confined to maintenance, annual dredging being necessary. The piers and revetments are in good condition. The project depth was available at the end of the fiscal year. The total amount expended under the project to June 30, 1916, was \$511,175.68, of which \$351,353.59 was for new work and \$159,822.09 for maintenance.

Local cooperation.—There were no conditions imposed by law as to cooperation. In 1896 and 1897 the Toledo & Ann Arbor Railway Co. (now the Ann Arbor Railroad Co.) extended the south pier 400 feet, at a cost of about \$25,000. Vessel terminals and revetments in the inner lake were constructed by railroad and other local interests.

Effect of improvement.—The improvement is of special benefit to interstate commerce, due to the operation between Frankfort and several harbors across the lake of a line of car ferries by the Ann Arbor Railroad Co., which carries over 99 per cent of the entire commerce of the harbor. This through-rail and car-ferry service is believed to have reduced the freight rates on such traffic.

Proposed operations.—The funds available for maintenance will be expended by March 1, 1917, for operation and repair of dredge *Meade* and incidentals.

The river and harbor act approved July 27, 1916, provided \$5,000 for maintenance, which will be used for maintenance dredging by U. S. dredge *Meade* and engineering and contingencies. The funds will be exhausted June 30, 1917.

Annual dredging is required for maintenance, piers require additional filling where the stone has settled, and the harbor structures require occasional repairs and renewals. The following estimate is submitted for maintenance during the fiscal year ending June 30, 1918:

Operation and repair of dredge <i>Meade</i>	\$5,500
Stone filling for both piers. 1,700 tons.....	3,400
Maintenance of existing works.....	1,600
Operation and repair survey and inspection steamer <i>Hancock</i>	1,000
Engineering and contingencies.....	600
Total.....	12,100

Commercial statistics.—The commerce for 1915 consisted largely of coal, lumber, and grain products.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	764,459	\$19,919,135
1914.....	737,248	18,818,077
1915.....	718,899	21,806,293

Amount expended on all projects from June 23, 1866, to June 30, 1916:

New work.....	\$351,353.59
Maintenance	159,822.09
Total	511,175.68

Balance available for fiscal year ending June 30, 1917..... 5,993.60

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 12,100.00

CHARLEVOIX HARBOR, MICH.

Location and description.—This harbor is located on the east shore of Lake Michigan about 275 miles from Chicago and about 45 miles from the Straits of Mackinac. It is at the mouth of Pine River, which connects Lake Michigan through the lower channel with Round Lake and thence Round Lake through the upper channel with Pine Lake. Round Lake is about one-half mile in diameter and Pine Lake is about 14 miles long, both being navigable. The distance from Lake Michigan to Pine Lake is about 1 mile.

Existing project.—The existing project as adopted by the river and harbor act of August 14, 1876, provided for a channel 12 feet deep from Lake Michigan to Round Lake, protected by piers and revetments, at an estimated cost of \$186,000. The river and harbor act of August 2, 1882, extended the project to include the channel from Round Lake to Pine Lake. The project depth was increased to 15 feet below low water (2 feet below mean lake level 1860–1875), for a channel from Lake Michigan to Pine Lake, by river and harbor act of June 13, 1902. There is no approved estimate of cost for maintenance. As built the width between piers of the lower channel (Lake Michigan to Round Lake) is 160 feet at the entrance, narrowing to 100 feet, and between the revetments of the upper channel (Round Lake to Pine Lake) is 83 feet. The latest published map is in House Document No. 26, Sixty-third Congress, first session.

Condition at the end of fiscal year.—The lower channel, from Lake Michigan to Round Lake, about 2,000 feet long and 15 feet deep below low water, with a width of 160 feet at the entrance, narrowing to 100 feet, had been constructed, with a north pier and revetment 1,725 feet long and south pier and revetment 2,030 feet long. The upper channel, from Round Lake to Pine Lake, about 1,500 feet long, had been dredged to a depth of 15 feet below low water, completing the project dredging August, 1902, and revetments 83 feet apart built for lengths of 339 feet on the north side and 366 feet on the south side. The project had been completed with the exception of 200 feet

extension to the south pier, which has been deferred, entrance depths being maintained by dredging alone. Present operations are confined to maintenance. The piers and revetments are in fair condition. The project depth was available at the end of the fiscal year. The total amount expended under the existing project to June 30, 1916, was \$223,285.51, of which \$80,205.04 was for new work and \$143,080.47 for maintenance.

Local cooperation.—There were no conditions imposed by law as to cooperation. Prior to the beginning of work by the United States some dredging had been done in both the lower channel and in the upper channel, and a north pier 468 feet long and a south pier 80 feet long had been built at the Lake Michigan entrance. This work was done by citizens, assisted by a grant of land from the State.

Effect of improvement.—The effect on freight rates is not known. The principal traffic is lumber, iron ore, and pig iron, in connection with the industries at the head of Pine Lake.

Proposed operations.—The funds available for maintenance will be exhausted by about March 1, 1917, for operation and repair of dredge *Meade* and incidentals.

No estimate is submitted for completion of the project, as entrance depths are now maintained by dredging. The river and harbor act approved July 27, 1916, provided \$3,500, which will be used for dredging by U. S. dredge *Meade*, maintenance of existing works, and engineering and contingencies. The funds will be exhausted by June 30, 1917.

Annual dredging is required for maintenance; the north pier requires about 800 tons of riprap where the lake bottom is below the bottom of the cribs, about 600 tons of stone filling is required in the outer portions of the piers where settlement has taken place, and the harbor structures require occasional repairs and renewals. The following estimate is submitted for maintenance for the fiscal year ending June 30, 1918:

Operation and repair U. S. dredge <i>Meade</i>	\$3, 000
Riprap and stone filling.....	3, 000
Maintenance of existing works.....	600
Engineering and contingencies.....	500
Total.....	7, 100

Commercial statistics.—The commerce for 1915 was about 64 per cent iron ore and pig iron, and 32 per cent forest products; the increase over 1914 was due to increase in lumber shipments.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	198, 160	\$1, 978, 757
1914.....	155, 902	1, 606, 400
1915.....	172, 052	1, 574, 763

Amount expended on all projects from Aug. 14, 1876, to June 30, 1916:

New work	\$80, 205. 04
Maintenance	143, 080. 47
Total	<u>223, 285. 51</u>

Balance available for fiscal year ending June 30, 1917.....	5, 076. 13
Amount (estimated) required to be appropriated for completion of existing project	23, 750. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	7, 100. 00

ALPENA HARBOR (THUNDER BAY RIVER), MICH.

Location and description.—This harbor is located on the northwest shore of Thunder Bay, Lake Huron, and on the lower reach of the Thunder Bay River, and is 96 miles distant in a northerly direction from Harbor Beach, Mich. The river, which is about 45 miles long, has its source in Montmorency and Alpena Counties, Mich., flows in an easterly direction, and empties into Thunder Bay.

Existing project.—The existing project provides for a channel depth of 16 feet from the 16-foot contour in Thunder Bay to a point 1 mile above the mouth of the river, with widths varying as follows: 200 feet at the 16-foot contour in the bay, thence tapering to 100 feet at the lighthouse crib, thence 100 feet to the Second Street Bridge, thence 75 feet to the Miner Lumber Co.'s wharf, thence 50 feet to the upstream limit of the improvement. The estimated cost of this channel was \$36,087.48. No estimate of cost of maintenance was made. This project was adopted by the act of September 19, 1890, in accordance with reports printed in the Annual Report of the Chief of Engineers for 1889, pages 2288–2290. The adopted plane of reference for work at this harbor is 579 feet above mean tide at New York. The total length of the section of the river included in the project is 4,050 feet, and the improved channel extends a further distance of 2,500 feet out in the bay. A map of the improvement will be found opposite page 1985 of the report of the Chief of Engineers for 1903.

Condition at the end of fiscal year.—The work done at this harbor has consisted of dredging to deepen and widen the channel and of placing rock piles on the outer ends of the slab piers at the entrance to the river to prevent their destruction by wave action. The widths and depth called for by the existing project have been secured and maintained. The controlling depth at the end of the fiscal year at the project plane of reference was 12.5 feet. The total expenditures under the existing project up to the end of the fiscal year are \$21,300.47 for new work and \$35,253.14 for maintenance, a total of \$56,553.61. The project was completed in the fiscal year 1894.

Local cooperation.—No conditions were imposed by law at the time of the adoption of any of the projects for work at this locality. Prior to the time work of improvement was undertaken by the United States the Alpena Harbor Improvement Co., acting under a charter granted by the State of Michigan in 1865, improved the mouth of the river by building piers and by dredging. The piers were formed of cribs sunk with stone and having a superstructure of slabs. The

amount expended by this company was about \$40,000. Some dredging was also done during the spring of 1875 by private parties at a cost of about \$3,000, and since the improvement of the harbor was begun by the United States dredging has been done by private parties at various times.

Effect of improvement.—The effect of the improvement upon local freight rates has been very beneficial, as it is estimated that they have been decreased almost one-half since the improvements were made.

Proposed operations.—It is not proposed to do anything with the funds now available until more money is provided.

It is estimated that to restore the project depth in this channel will require the removal of approximately 37,000 cubic yards of material at an estimated cost, including contingencies, of \$9,000, or \$5,000 in addition to the amount now available. An estimate for this amount is submitted.

Commercial statistics.—The commerce of the harbor consists of stone, coal, cement, tan bark, and miscellaneous merchandise.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	938, 217	\$3, 249, 263
1914.....	1, 141, 412	3, 604, 806
1915.....	1, 166, 770	3, 121, 282

Amount expended on all projects from Aug. 14, 1876, to June 30, 1916:

New work.....	\$40, 189. 17
Maintenance	35, 253. 14
Total	75, 442. 31

Balance available for fiscal year ending June 30, 1917.....	4, 057. 69
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	5, 000. 00

HARBOR OF REFUGE AT HARBOR BEACH, MICH.—NEW PROJECT.

Report of the Chief of Engineers:

Harbor Beach is an artificial harbor located on the west shore of Lake Huron, about 60 miles north of the city of Port Huron. Its construction was authorized by the river and harbor act of March 3, 1871, and the plan subsequently approved provided for breakwaters having an aggregate length of 7,000 feet, at an estimated cost of \$1,452,550. Since 1907 maintenance and renewal of the breakwaters have been carried on in general conformity with the recommendations contained in a report submitted under authority of the act of March 3, 1905, and printed in House Document No. 900, Fifty-ninth Congress, first session. The deepening of the harbor and main entrance and the closing of the north entrance, contemplated by that report, however, have not been undertaken. The district officer states that there has been considerable shoaling near the north entrance and that if this entrance be closed the maintenance of the harbor will be much easier and less expensive. To fit the harbor for use by large vessels navigating the Lakes, he recommends that the north entrance be closed, that the main entrance be dredged to a depth of 25 feet, and that the area shown on the map be dredged to a depth of 23 feet, referred to a datum plane 579 feet above mean tide at New York, at a total estimated cost of \$425,000. The division engineer recommends that the north entrance be closed, that the main entrance be deepened to 23 feet, and the

harbor basin area to 21 feet at low water, elevation 579.6 above mean tide at New York, at a total estimated cost of \$206,000. The Board of Engineers for Rivers and Harbors concurs in the views of the division engineer.

I concur in the views of the division engineer and the Board of Engineers for Rivers and Harbors, and therefore recommend legislation authorizing a modification of the existing project for the harbor of refuge at Harbor Beach, Mich., so as to provide for closing the north entrance, dredging the main entrance to a depth of 23 feet and the anchorage area as marked on the accompanying map to 21 feet, referred to elevation 579.6 above mean tide at New York, at a total estimated cost of \$206,000, and \$10,000 annually thereafter for maintenance.

KEWEENAW WATERWAY, MICH.

Location and description.—Keweenaw Waterway is a navigable channel 25 miles long, partly natural and partly artificial, across Keweenaw Point, Mich., with its upper or westerly entrance 166.5 miles east of Duluth, Minn., and its lower or easterly entrance 205.5 miles west of Sault Ste. Marie, Mich.

Existing project.—The original project was adopted by the river and harbor act of September 19, 1890 (H. Doc. No. 105, 49th Cong., 2d sess.), and provided for a 16-foot channel of 70 feet bottom width from bay to lake; the renewal of canal revetments; the reconstruction and extension of piers at Lake Superior entrance to 30-foot depth of water; the extension of the pier at the Keweenaw entrance to 20-foot depth of water; and at the proper time to increase the channel depth to 20 feet, with bottom width of not less than 120 feet. By modification approved March 15, 1898, the increase in width and depth of channel was authorized.

The project was further modified by the river and harbor act of June 25, 1910 (H. Doc. No. 325, 60th Cong., 1st sess.), and provided for an anchorage basin just within the lower entrance about one-half mile long, 800 feet wide, a mooring pier on its westerly edge 2,000 feet in length, and the purchase of the necessary land.

The existing project then provides for a navigable channel across Keweenaw Point approximately 25 miles long, 20 feet deep, with least bottom width of 120 feet, with necessary pile and timber revetments; a stone-filled timber pier at the lower entrance extending to 20-foot depth of water 3,700 feet long; converging stone-filled timber piers at upper entrance with westerly pier 2,745 feet long and easterly pier 2,485 feet; with an upper entrance anchorage basin 3,600 feet long by 600 feet wide, with 3,600 feet of pile-timber mooring piers; and a lower anchorage basin one-half mile long and 800 feet wide, with a pile-timber mooring pier 2,000 feet long.

The reference plane for this harbor is low-water datum, which is 601.75 feet above mean tide at New York.

The approved estimated cost of the original project was \$2,375,000; that of the modification provided for by act of June 25, 1910 (H. Doc. No. 325, 60th Cong., 1st sess.), \$210,000, making a total for the existing project of \$2,585,000. No estimate for maintenance.

The latest published maps are contained in the Annual Report for 1903, page 1816, and House Document No. 325, Sixtieth Congress, first session.

Condition at the end of fiscal year.—A navigable channel 25 miles long across Keweenaw Point with 20 feet depth and minimum width of 120 feet protected at both upper and lower entrances by break-

waters of stone-filled timber cribs aggregating in total 8,690 feet in length. Stilling basin behind breakwaters at upper entrance. Harbor basins conveniently located at both entrances. The proportion of the existing project accomplished is estimated at 99 per cent. The dredging done in the harbor of refuge has resulted in giving an available basin about 730 feet wide and one-half mile long, with a depth of 20 feet below low-water datum, and the depth increased from an average of about 6 feet before dredging to a depth of 20 feet. The maximum draft that can be carried throughout the waterway is 19½ feet at low-water datum. The total expenditure under the existing project is \$1,847,805.36, of which \$1,786,379.34 was for improvement and \$61,426.02 for maintenance. The original project provided by the river and harbor act of September 19, 1890, was completed in the fiscal year of 1906 for \$715,000 less than the original estimate. The breakwaters at the upper entrance were completed in 1902; the breakwater at the lower entrance in 1900. The canal revetments were completed in 1902.

Effect of improvement.—Navigation has been rendered safer through the waterway by its improvement and commercial facilities by connections with railroads which serve this important copper-mining district. The harbor basin is utilized by vessels. Water rates have been materially reduced through the enlargement of this waterway by the United States, allowing the use of larger vessels for the transportation of freight. It can not be determined that any reduction in rail rates has been effected, which is believed to be due to the fact that the railroads have to a large extent owned the vessel lines from the date of acquisition by the United States of the waterway up to the present year. The number of vessels using the upper harbor of refuge was 195, tonnage 411,729; at lower harbor of refuge was 56, tonnage 46,512, the lower harbor of refuge being available only for part of 1915. For average haul and rate per ton-mile see tables at end of report of the district officer.

Proposed operations.—It is proposed to complete the harbor of refuge as projected, the available funds being considered sufficient. The work remaining is building 900 feet of mooring pier, now 60 per cent completed, and the dredging of 100,000 cubic yards of sand. This will be done with United States plant and hired labor and the purchase of material. It is contemplated to complete it during the present working season. It is proposed to repair the breakwaters at upper entrance, the superstructures of which are now in an advanced stage of deterioration.

These breakwaters are stone-filled cribs 30 feet wide, with stone-filled timber superstructures with sloping face to seaward side. They rest upon a stone embankment where depth of water is greater than 20 feet, with bearing piles spaced 8 feet under walls. Length of west breakwater 1,900 feet and of east breakwater 1,700 feet. Each breakwater has an L at the entrance. They have shore arms aggregating 1,630 feet. Total cost, \$333,538.52. The plan for reinforcement is to use large rubblestone to build a sea slope and replace a part of the superstructure. It is also proposed to remove the two 100-foot ells, as they are deemed a detriment to the entrance. It is further proposed to convert the entrance ends of the breakwaters

into pierheads by reinforcement of interlocking steel sheet piling and to build a concrete superstructure on each pierhead.

Additional funds will be required for maintenance of the waterway for the fiscal year ending June 30, 1918, and an estimate of \$105,000 is submitted, as follows:

For upper entrance breakwaters:

37,144 tons of rock in place, at \$1.40 per ton-----	\$52,001. 60
Preparation of superstructure, west breakwater----	3,800. 00
Removing west L-----	4,000. 00
Reinforcing 2 pierheads-----	15,917. 60
Administration and contingencies-----	14,280. 80
	<u>\$90,000. 00</u>

For channel and general maintenance:

Operation of dredging plant, proportionate part----	4,000. 00
Operation of derrick scow and steam tug-----	6,000. 00
Maintenance of buildings, care and preservation of United States property, administration, and con- tingencies-----	5,000. 00
	<u>15,000. 00</u>

Total ----- 105,000. 00

It is recommended as economical and expedient that the remaining \$66,000, for repairs to breakwaters, be provided for under continuing contract.

Commercial statistics.—The greater portion of the freight business of 1915 was carried on by boats drawing $12\frac{1}{2}$ to $19\frac{1}{2}$ feet of water and represents about 99 per cent of the total tonnage of through and local commerce. All other freight business was carried on by boats drawing from 6 to $12\frac{1}{2}$ feet of water and represents about 1 per cent of the total tonnage. Commerce through the waterway, westbound, consists principally of miscellaneous merchandise, coal, manufactured iron, salt and cement; eastbound freight consists principally of flour, lumber, grain, and iron ore. Freight received at ports within the waterway consists principally of coal, miscellaneous merchandise, manufactured iron, and cement. Freight shipped from ports within the waterway consists principally of copper, lumber, and stamp sand.

Comparative statement.

Year.	Through commerce.		Local commerce.	
	Short tons.	Value.	Short tons.	Value.
1913.....	1,200,313	\$50,894,518	1,060,247	\$21,655,816
1914.....	823,556	47,431,947	1,077,032	22,578,204
1915.....	1,088,293	66,091,564	1,374,636	44,322,561

Amount expended on all projects from Sept. 19, 1890, to June 30, 1916:

New work -----	\$1,786,379. 34
Maintenance -----	61,426. 02

Total ----- 1,847,805. 36

July 1, 1916, balance available-----	31,539. 96
Amount (estimated) required to be appropriated for completion of existing project-----	50,000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	105,000. 00

KEWEENAW WATERWAY AT PRINCESS POINT, MICH.—NEW PROJECT.

Report of the Chief of Engineers printed in House Document No. 835, Sixty-third Congress, second session:

Keweenaw Waterway is a navigable channel 25 miles long across Keweenaw Point, a peninsula on the south shore of Lake Superior, lying about midway between Sault Ste. Marie and Duluth. The waterway has a clear width of 120 feet and a depth of 20 feet at mean low water throughout its entire length, but at Princess Point the channel makes a sharp turn, having a radius of 835 feet for a distance of a quarter of a mile. The district officer states that the larger vessels have experienced difficulty in making the turn at this point, and a number of groundings and collisions have occurred during the last five years. The improvement desired is the making of a cut-off to remedy this difficulty. He submits two plans for the improvement, one contemplating a straight channel at an estimated cost of \$155,280, and the other a curved channel at an estimated cost of \$138,000. The latter plan is not only less costly but appears to be preferred by navigators, and the district officer is of opinion that the locality is worthy of improvement in accordance with this plan. The division engineer expresses the opinion that Keweenaw Waterway is not worthy of improvement by the United States to the extent of making a cut-off at Princess Point.

I concur with the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of Keweenaw Waterway is deemed advisable to the extent of making a cut-off at Princess Point, under the plan contemplating a curved channel, as shown on accompanying map, 200 feet wide on bottom and 20 feet deep at mean low water, at an estimated cost of \$138,000. The cost of maintaining the waterway will not be increased by the improvement now proposed.

SHIP CHANNEL CONNECTING WATERS OF THE GREAT LAKES BETWEEN CHICAGO, DULUTH, AND BUFFALO.

Location and description.—This channel comprises the St. Marys River, Lake Huron, the St. Clair River, Lake St. Clair, and the Detroit River.

Existing project.—The existing project, authorized by act of July 13, 1892, provides for the construction of a ship channel 20 and 21 feet deep and not less than 300 feet wide in the shallows of the connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo. The estimated cost was \$3,340,000. No estimate of cost of maintenance was made. The project was based upon a report of preliminary examination contained in House Executive Document No. 207, Fifty-first Congress, second session. The project called for depths of 20 and 21 feet below mean low water, which is assumed to have been at 601.5 feet above mean tide at New York for Lake Superior; 584.2 at foot of locks, St. Marys River; 581.1 for Lake Huron; 575.5 for Lake St. Clair; and 572.6 for Lake Erie. The river and harbor act approved July 27, 1916, adopted the project submitted in House Document No. 782, Sixty-fourth Congress, first session, which contemplates securing a channel in St. Clair River along the water front of Port Huron, Mich., of adequate width and depth (21 feet at low water and 400 feet wide), including a submerged weir below the channel, at an estimated cost of \$83,325 for first construction and \$1,000 annually for maintenance. The planes of reference for work under this project have been changed as follows: 580.4 at foot of locks; 578.9 at Mud Lake, St. Marys River; 578.8, lower St. Marys River; 579.6, foot of Lake Huron; 573.8, St. Clair Flats Canal; and 573.8, Grosse Pointe Channel. A map of the improvement is pub-

lished in House Document No. 266, Fifty-ninth Congress, second session.

Condition at the end of fiscal year.—All the work done upon this improvement has been the widening and deepening of channels by dredging and rock removal. The improved channels are nowhere less than 300 feet wide, nor less than 21 feet deep referred to the datum planes of the existing project as originally adopted (1892). This project is regarded as having been completed in the fiscal year 1909. The project depth referred to the datum planes now in use has been provided at nearly, but not quite, all of the localities covered. The increased depth given by this work varies from about 4 to about 14.5 feet. At the end of the fiscal year the controlling depth referred to the present datum planes was 19 feet. During the navigation season the water level may vary from zero to about 2.5 feet above the adopted datum planes, and the draft which can be carried varies accordingly.

The total amount expended to the end of the fiscal year is \$3,340,025 for new work and \$51,375.16 for maintenance, a total of \$3,391,400.16.

Effect of improvement.—This improvement affects the entire commerce of the Great Lakes passing between the points covered by the project. It is believed that to attribute to the improvement in channels the differences in freight rates of 1900 (1.18 mills per ton-mile) and 1915 (0.71 mill per ton-mile) would not exaggerate the effect of the improvement, especially in view of the fact that the greater permissible draft has resulted in the use of vessels of greater tonnage, the carrying capacity of the largest freight steamers having increased from 8,000 tons in 1900 to 14,280 tons.

Proposed operations.—(a) With the funds now available the work of dredging in Lake St. Clair now in progress under contract will be continued and completed, and the work of securing a channel in the St. Clair River along the water front of Port Huron, Mich., will be done. The work of dredging in Lake St. Clair is being prosecuted at the rate of about 90,000 cubic yards per month, and it is expected that it will be completed well within the contract time of completion, November 26, 1916. The work of securing channel in St. Clair River will probably be done during the season of 1917.

(b) With the funds to be furnished under the estimate submitted in this report it is proposed to do dredging to restore to project depth and width the portion of the ship channel at Grosse Pointe Channel, Lake St. Clair, that remains after the contract now in progress is completed. This will require the removal of approximately 1,750,000 cubic yards at an estimated cost of 15 cents per cubic yard, or a total of \$284,000, including contingencies, the amount of the estimate herein. This channel, which is now the point of least depth in the ship channel connecting the Lakes, was completed in 1905, since which time no work of redredging has been done and considerable shoaling has taken place.

Commercial statistics.—See statements of commercial statistics in reports upon St. Marys Falls Canal, Mich.; St. Clair Flats Canal, Mich.; and Detroit River, Mich.

Amount expended on all projects from July 13, 1892, to June 30, 1916:

New work-----	\$3, 340, 025. 00
Maintenance-----	51, 375. 16
Total-----	<u>3, 391, 400. 16</u>
Balance available for fiscal year ending June 30, 1917-----	111, 272. 72
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	284, 000. 00

ROUGE RIVER, MICH.

Location and description.—The Rouge River rises in Oakland and Washtenaw Counties, Mich., flows in an easterly direction, and empties into the Detroit River at the southerly limits of the city of Detroit. The river is about 30 miles in length. The drainage area is about 450 square miles. The discharge is not known. The river is nontidal and the current sluggish, the fall being practically nothing in the improved portion of the river. Average width, 160 feet.

Existing project.—The existing project provides for dredging a channel 21 feet deep from the mouth of the river to the first bridge, a distance of about 1,800 feet, with a width of 240 feet at the mouth, tapering to 100 feet at a distance of 800 feet from the mouth, a channel 16 feet deep and 100 feet wide from this first bridge to the Wabash railroad bridge and a channel 13 feet deep (width not specified) thence to Maples Road. The length of the section covered by this project is $4\frac{1}{2}$ miles. The estimates of cost of this work are as follows: \$31,690.39 for the 16-foot channel from mouth to Wabash bridge, \$5,000 for the 13-foot extension to Maples Road, and \$3,575 for deepening channel to 21 feet at the mouth. No estimate of cost of maintenance of these channels was made except in the case of the 21-foot channel, which it was estimated would require \$3,000 annually to maintain. The work was originally authorized by act of August 11, 1888, and was based upon report of examination and survey contained in Report of the Chief of Engineers for 1887, pages 2275–2278. The extension to Maples Road was authorized by joint resolution of April 11, 1898, and was based upon report contained in House Document No. 138, Fifty-fifth Congress, second session. The increase in depth at the mouth was authorized by act of March 2, 1907, and was based upon report contained in House Document No. 289, Fifty-ninth Congress, first session. The adopted reference plane for work under this project is 572.5 feet above mean tide at New York. A map showing the improvement will be found opposite page 1994, Report of the Chief of Engineers for 1903.

Condition at the end of fiscal year.—All the work done on this river has been dredging to deepen the channel, and it has resulted in securing a channel of the project widths and depths. The controlling depths at the end of the fiscal year at the project plane of reference are 16 feet to the Solvay Bridge, 13.5 feet to the Wabash Bridge, and 12.5 feet to Maples Road. Except during floods, the level of the river fluctuates with that of the Detroit River, generally during the navigation season from zero to 1.5 feet above the project datum plane, and the available depth varies accordingly. The total expenditures under the existing project up to the end of the fiscal

year are \$50,082.49 for new work and \$50,988.77 for maintenance; a total of \$101,071.26. The project was completed during the fiscal year 1908.

Effect of improvement.—As a result of this improvement the area suitable for the establishment of manufacturing plants in the vicinity of Detroit has been greatly enlarged and freight rates to points along the river have been materially reduced.

Proposed operations.—No work of any amount has been done to maintain the improved channel since 1912. A recent examination shows that there has been considerable shoaling since that time and that it will require the removal of approximately 75,000 cubic yards of material to restore the channel depth and width, and it is estimated that this will cost, including contingencies, about \$7,000 in addition to the available balance of \$5,618.74. An estimate for this amount is therefore submitted.

Commercial statistics.—The commerce of the river consists mainly of gravel and sand, iron ore, petroleum products, stone, pulp wood, and lumber.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	1,684,742	\$4,401,466
1914.....	1,439,932	3,301,782
1915.....	1,651,823	3,759,224

Vessels carrying freight on the improved portion of the channel usually load to the maximum draft available.

Amount expended on all projects from Aug. 11, 1888, to June 30, 1916:	
New work	\$50,082.49
Maintenance	50,988.77
Total	101,071.26
July 1, 1916, balance unexpended.....	5,618.74
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	
	7,000.00

CLINTON RIVER, MICH.

Location and description.—This river has its source in Oakland County, Mich., flows in an easterly direction, and empties into Anchor Bay, in the northwestern part of Lake St. Clair. It is about 60 miles long.

Existing project.—The existing project, adopted by act of August 5, 1886, provides for a depth of 8 feet from the 8-foot contour in Lake St. Clair to the city of Mount Clemens, the construction of a pile dike across the flat at the mouth and of revetments as needed above the mouth, for closing the main channel and making a straight cut through Shoemakers Bend, and for closing Catfish Channel. The adopted reference plane for dredging is 573.6 feet above mean tide at New York. The length of the section of the river included in this project is about 42,500 feet, including a cut 2,500 feet long out into the lake. The original estimated cost was \$25,000, revised and

amended in 1888 and 1889 to \$34,564. No estimate of cost of maintenance was made. The project is based upon reports of examination and survey contained in Senate Document No. 199, Forty-sixth Congress, second session, and House Document No. 210, Forty-eighth Congress, second session. A map showing the improvement will be found at page 1999, Report of the Chief of Engineers for 1903.

Operations and results during the fiscal year.—The work which has been done on this river during the past fiscal year was for maintenance of the improved channel. For this purpose \$13,900 cubic yards of material were removed mainly at the mouth of the river, where it was necessary to do dredging at two different times during the year. A small amount of dredging was also done at the upper end of the improvement. The expenses in connection with this work are as follows: Hire of dredge, \$1,085.83; incidental expenses, \$100; a total of \$1,185.83. During the year \$1,065.03 was expended, all for maintenance.

Condition at the end of fiscal year.—The work done on this river has been dredging to deepen the channel and the construction of a pile dike at the mouth and of revetments above the mouth, and it has resulted in providing the depths called for by the project. The controlling depth at the end of the fiscal year at the project plane of reference was 6 feet. Except during floods, the level of the river fluctuates with that of Lake St. Clair, generally during the navigation season, from zero to 1.5 feet above the project datum plane, and the available depth varies accordingly. The total expenditures under the existing project up to the end of the fiscal year are \$34,546.26 for new work and \$39,438.34 for maintenance, a total of \$73,984.60. The project was completed in the fiscal year 1894.

Local cooperation.—No conditions were imposed by law at the time of adoption of any of the projects. In the spring of 1884 the people of Mount Clemens contributed to a fund, which was expended in deepening the channel from the lake to that city. The city also deeded to the United States for a nominal sum the land needed to rectify the channel at Shoemakers Bend.

Effect of improvement.—The effect of the improvement on freight rates can not be determined.

Proposed operations.—It is not proposed to do anything with the funds now available, unless an emergency should make it necessary to do some dredging before additional funds are provided.

It is estimated that to do in the most advantageous manner such work of redredging as may be necessary \$1,500 in addition to the amount now available should be provided, and an estimate for this amount is submitted.

Commercial statistics.—The commerce of the river consists of coal, logs, bolts, and salt.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	22,683	\$40,256
1914.....	14,108	40,872
1915.....	14,352	31,777

Amount expended on all projects from Aug. 30, 1852, to June 30, 1916:

New work-----	\$60, 046. 26
Maintenance -----	39, 438. 34
Total-----	<u>99, 484. 60</u>
Balance available for fiscal year ending June 30, 1917-----	1, 993. 57
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	1, 500. 00

HARBOR AT PORT WING, WIS.

Location and description.—The harbor is situated on the south shore of Lake Superior, 34 miles east of Duluth. It has a width of 200 feet and a length of about 2,000 feet, and consists of the improvement of the mouth of Flag River.

Existing project.—The existing project provides for a channel 150 feet wide with 15-foot depth to be dredged between the piers and 500 feet along the pile revetment parallel to the spit. The depths are referred to low-water datum, which is 601.75 feet above mean tide at New York. It also provides for the construction of two parallel piers at the entrance 200 feet apart and 800 and 825 feet long, respectively, the piers to consist of two rows of piling, filled in with slabs and topped with large rock. At the inner end of the east pier a square return pile revetment to be constructed to preserve the sand spit from erosion, also a pile revetment along the east bank. The approved estimate of cost was \$44,992, which was increased to \$56,539 in 1908. There was no estimate for maintenance. (H. Doc. No. 114, 56th Cong., 1st sess., adopted by the river and harbor act of June 13, 1902.) For latest published map see Annual Report for 1903, page 1810.

Condition at the end of fiscal year.—Two entrance piers, 800 and 601 feet long, respectively, were constructed. A pile revetment 45 feet in length was built at the inner end of the east pier and at right angles to it, also a pile revetment 100 feet long at the inner end of the west pier to prevent erosion. An entrance channel 100 feet wide, and extending from deep water in the lake to a distance of 200 feet inside of the inner end of the east pier, and a portion of the turning slip 150 feet wide, and extending 200 feet east of the face of the east pier was dredged, all to a depth of 15 feet below low-water datum. The improvement has been maintained by dredging shoals and repairing piers. The proportion of the present project accomplished up to the end of the fiscal year is 80 per cent. Where originally there was an unstable depth of 13 feet there is now a channel 15 feet deep at low water, with a least width of 80 feet extending from deep water in the lake through the piers and 200 feet inside the inner end of the east pier, and a turning slip 150 by 200 feet to the east and inside of the end of the east pier, all permitting a draft of 14½ feet. Private interests maintain a channel along the lumber dock inside the harbor. This channel at the time of the last survey, June 11, 1915, had a depth of 13 feet below low-water datum, with a minimum width of 50 feet for a distance of 500 feet above the Government improvement. There remains 224 feet of the west pier and some pile revetment to build and dredging to widen the entrance channel 50 feet and extend the channel along the sand spit 300 feet, to finish the project. The

expenditures under the present project up to the end of the fiscal year, not including outstanding liabilities, were \$43,556.45 for improvement and \$30,315.61 for maintenance, a total of \$73,872.06.

Local cooperation.—The river and harbor act of June 13, 1902, by which the project was adopted, provided that before the commencement of operations the United States should be given a clear title, without cost, to all lands needed for the improvement. This provision was complied with by a deed to the United States, dated July 9, 1902, conveying 7 acres of land at the harbor entrance. Private interests have maintained a channel along the lumber wharf for distances varying at different times from 500 to 2,000 feet above the Government improvement. This channel fills up with material brought down the river by freshets and has to be redredged often.

Effect of improvement.—The construction of the harbor has been an essential factor in the development of the commerce of Port Wing, whereas there was practically none prior to commencement of improvements. All vessels of the class engaged in commerce with this port make use of the Government improvements. About 22 per cent of the vessels now using the harbor could do so without the aid of these improvements. This class requires a depth of 6 to 10 feet. The balance of the vessels (about 78 per cent) require a draft of 12 to 15 feet of water.

Proposed operations.—It is proposed to expend the available balance of \$5,119.94 for improvement in extending the west pier 224 feet to its full projected length in so far as the funds will permit. It is estimated that 160 linear feet can be built with the funds on hand and that they will be exhausted October 15, 1916, as follows:

In part for operation of United States floating derrick and pile driver	\$2,000.00
For purchase of materials	2,000.00
In part for administration and contingencies	1,119.94

Additional funds will be required for improvement and maintenance for the fiscal year ending June 30, 1918, and an estimate of \$8,000 is submitted. These funds will be expended as follows:

For improvement: To complete extension of 224 feet to west pier in part	
for operation of United States floating derrick and pile driver	\$1,600
For maintenance:	
Operation of U. S. dredge <i>Gaillard</i> , scows, and tug, in part	3,000
Operation of United States derrick scow, in part	2,000
Administration and contingencies	1,400
Total	8,000

The last dredging for the removal of shoals was done in 1913, and only minor repairs have been made to piers for some years. Shoals have encroached on the channel until there is a width of only about 80 feet of water 15 feet deep.

Commercial statistics.—Receipts consisted principally of miscellaneous merchandise; shipments consisted of fish and forest products.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	11,712	\$192,516
1914.....	1,986	78,541
1915.....	1,432	78,041

Amount expended on all projects from June 13, 1902, to June 30, 1916:	
New work -----	\$43, 556. 45
Maintenance -----	30, 315. 61
Total -----	<u>73, 872. 06</u>
Amount (estimated) required to be appropriated for completion of existing project -----	
<u>7, 862. 61</u>	
Amount that can be profitably expended in fiscal year ending June 30, 1918:	
For works of improvement -----	1, 600. 00
For maintenance of improvement -----	6, 400. 00
Total -----	<u>8, 000. 00</u>

ASHLAND HARBOR, WIS.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1698, Sixty-fourth Congress, second session:

Ashland Harbor is situated at the head of Chequamegon Bay, 95 miles easterly from Duluth. The present project provides for the construction of a breakwater 8,000 feet long, with a detached arm approximately 4,700 feet long extending to the shore parallel to the main breakwater and 2,600 feet to the eastward; a dike to close a breach in Chequamegon Point at the mouth of the bay, and a dredged channel 20 feet deep and 200 feet wide along the dock front. The total expenditures to June 30, 1915, were \$600,674.42, of which \$259,994.31 was for new work and \$340,680.11 for maintenance. The district officer is of opinion that the closure of the breach in Chequamegon Point is no longer required and that the easterly detached breakwater should be abandoned. He recommends that the project, which has heretofore been somewhat indefinite regarding certain features, be modified to read as follows:

“The construction and maintenance of an 8,000-foot breakwater and the construction and maintenance of a dredged channel 20 feet deep and 200 feet wide along the dock front, 75 feet outside the harbor line, from Ellis Avenue produced, to a point 400 feet westerly of Seventeenth Avenue west produced.”

The estimated cost of this project is \$269,994.31, including work already accomplished, leaving \$10,000 required to complete the improvement. Maintenance is estimated at \$6,000 annually. The division engineer and the Board of Engineers for Rivers and Harbors concur in the views of the district officer with the amendment that the depth be defined as 20 feet at low water, 601.6 feet above mean tide at New York.

I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors and therefore recommend legislation authorizing the modification and restatement of the project for improvement of Ashland Harbor, Wis., as specified above, the datum plane to be taken as 601.6 feet above mean tide at New York City.

GREEN BAY HARBOR, WIS.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 626, Sixty-fourth Congress, first session:

The harbor of Green Bay is situated at the head of Green Bay at the mouth of Fox River. The improvement maintained by the United States consists of an outer channel extending northerly in Green Bay from the mouth of Fox River a distance of about 4 miles, with a depth of 20 feet below mean lake level (581.63 feet above mean tide at New York City), and a width of 200 feet at the southerly end and 500 feet at the outer end, and an inner channel extending from the southerly limits of the city of Green Bay to the City of Depere, a distance of about 5 miles, having a depth of 17 feet and a width of 150 feet. Under the present investigation, consideration has been limited to the outer channel. Due to fluctuations of water level in Green Bay, the channel depth of 21 feet at mean low water named in the act would require a depth of 23 feet

below mean lake level. The commerce for 1914 aggregated 898,008 tons, of which over 80 per cent was coal. Many of the vessels handling this coal have a full-load draft of 19 to 20 feet, or about 1 to 2 feet greater than the actual available depth. From his study of the commercial situation the district officer is of the opinion that the commerce of this harbor has been retarded by the inadequate navigation facilities available, and he believes that some improvement of conditions is advisable. He submits estimates of cost for a channel 23 feet deep at mean lake level, with widths of 400, 300, and 200 feet, amounting to \$550,000, \$422,000, and \$247,500, respectively, and for a channel 22 feet deep and of similar widths, amounting to \$378,000, \$271,000, and \$110,000, respectively. In a supplemental report dated January 3, 1916, he also submits an estimate, amounting to \$44,000, for increasing the depth of the present channel to 21 feet below mean lake level. He believes the locality worthy of improvement to the extent of providing a channel 22 feet deep below mean lake level, with a minimum width of 200 feet, at an estimated cost of \$110,000 for the first construction and \$12,000 annually for maintenance. The division engineer concurs in this opinion but believes that the project depth should be designated as 20 feet at low water.

I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of the harbor at Green Bay, Wis., is deemed advisable to the extent of deepening the outer channel to 20 feet at mean low water or 22 feet at mean lake level (581.63 feet above mean tide at New York City), with a minimum width of 200 feet, at an estimated cost of \$110,000 for first construction and \$12,000 per annum for maintenance.

GREEN BAY HARBOR, WIS.—MODIFICATION OF PROJECT FOR, TO INCLUDE THE MAINTENANCE OF THE TURNING BASIN IN DEPERE HARBOR.

Report of the Chief of Engineers, printed in House Document 1017, Sixty-fourth Congress, first session.

The city of Depere is situated on the Fox River about 5 miles from the city of Green Bay. The existing project, adopted by the act of June 25, 1910, provides for a turning basin having a depth of 17 feet. The project has been completed and simply requires maintenance. The channel in the Fox River between the city of Green Bay and Depere has been dredged and maintained at a depth of 17 feet below mean lake level under appropriations for improvement of Green Bay Harbor, Wis. The district officer states that the turning basin at Depere is simply an adjunct of the inner Green Bay Harbor Channel, and he recommends that it be dropped as a separate project, and its future maintenance, estimated to cost \$600 per annum, be included in the project for improvement of Green Bay Harbor, Wis.

I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore recommend legislation authorizing the modification of the project for improvement of Green Bay Harbor, Wis., to include the maintenance of the turning basin at Depere.

STURGEON BAY AND LAKE MICHIGAN SHIP CANAL, WIS.

Location and description.—This improvement is on the west shore of Lake Michigan, distant about 47 miles northeasterly from Green Bay and about 128 miles northerly from Milwaukee. It consists of a revetted canal 7,200 feet long connecting Lake Michigan and Sturgeon Bay, a basin having an area of about 12 acres inclosed by breakwaters at the Lake Michigan end of the canal, and a dredged channel about 4 miles long connecting the westerly end of the canal with deep water in Sturgeon Bay.

Existing project.—The existing project, adopted by the river and harbor act of June 13, 1902, provides for increasing the depth throughout the improvement to 21 feet; estimated cost, \$222,000. (H. Doc. No. 117, 56th Cong., 2d sess.) The plane of reference is

581.63 feet above mean tide at New York City, being the mean lake level of Lake Michigan for the years 1860-1875.

The present complete plan of improvement provides for a basin protected by two converging timber breakwaters, each 1,344 feet long, at the easterly or Lake Michigan end of the canal, through which a channel has been dredged for an average width of 160 feet, and 600 feet wide beyond the basin, extending to deep water in Lake Michigan; a timber-revetted canal 7,200 feet long, 160 feet wide for the easterly 6,200 feet and 250 feet wide for the westerly 1,000 feet; and a channel in Sturgeon Bay from westerly end of canal, about 4 miles long and 200 feet wide.

For latest published map, see House Document No. 1382, Sixty-second Congress, third session.

Condition at the end of fiscal year.—The existing project was completed during the fiscal year ending June 30, 1905. The controlling depth throughout the improvement at the end of the fiscal year is 21 feet at the project plane of reference. Repairs are needed to the canal revetments. The harbor piers are generally in good condition. The expenditures under existing project were \$236,217.45 for improvement, \$19,125.69 for maintenance, a total of \$255,343.14.

Effect of improvement.—The principal effect is the shortening of the distance from ports on the west shore of Lake Michigan to Menominee Harbor by about 50 miles and to Green Bay Harbor by about 70 miles. It has likewise afforded shelter to vessels during storms. The following vessels sought shelter during the past fiscal year: Steamers, 41; sailing vessels, 32; unriggered vessels, 11; total, 84. Approximate total value of cargoes carried by vessels seeking shelter, \$233,760. It is believed that the project has a material effect in controlling freight rates on bulk commodities, such as coal, grain, and lumber. It is impracticable to estimate the amount of reduction in rates thereby effected.

Proposed operations.—The following estimate is submitted for maintenance of the canal and works incident thereto to June 30, 1918:

Operation of U. S. dipper dredge <i>Keewaunee</i> one-half month, at \$4,000	___	\$2, 000
Repairing 1,200 linear feet of canal revetments, at \$7.50	-----	9, 000
Minor repairs to entrance piers	-----	500
Repairs of plant and buildings	-----	1, 000
Engineering and contingencies	-----	2, 500
Total	-----	15, 000

Commercial statistics.—The general character of the commerce for the current year is cement, coal, dairy products, fish, lumber, manufactured iron, and general merchandise. The usual limit of draft of coal and grain-carrying vessels is 18.5 feet, and vessels carrying lumber, stone, and general merchandise, 15 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	548, 660	\$12, 331, 535
1914.....	499, 634	12, 217, 524
1915.....	539, 695	11, 956, 223

Amount expended on all projects from Mar. 3, 1873, to June 30, 1916:

New work-----	\$559, 636. 85
Maintenance -----	49, 825. 55
Total -----	<u>609, 462. 40</u>

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement----- 15, 000. 00

TWO RIVERS HARBOR, WIS.

Location and description.—This harbor is on the west shore of Lake Michigan, distant about 79 miles northerly from Milwaukee and about 97 miles from Green Bay via Sturgeon Bay Canal. The harbor is at the mouth of the Twin Rivers and consists of a basin having an area of about 4 acres and a channel extending therefrom to deep water in Lake Michigan.

Existing project.—The existing project, adopted March 2, 1907, is a modification of plan A, printed in House Document No. 730, Fifty-ninth Congress, first session, containing latest published map, and provides for increasing the depth of channel to 16 feet and for the construction of a stilling basin on the north side of harbor. The sum of \$90,000 was appropriated for the purpose. The plane of reference is 581.63 feet above mean tide at New York City, being the mean level of Lake Michigan for the years 1860–1875.

The present complete plan of improvement provides for a channel 1,700 feet long, 240 feet wide, protected by timber crib and pile piers and revetments, leading to an interior basin, and a stilling basin of about 3½ acres area on the north side of the channel.

Condition at the end of fiscal year.—The project was completed during the fiscal year ending June 30, 1910. The controlling depth at the end of the fiscal year is 16 feet at the project plane of reference. The piers are in generally good condition except for a small amount of stone needed for filling pockets. The revetment in front of United States Coast Guard station is in bad condition. The expenditures under existing project were \$53,559.40 for improvement, \$59,436.77 for maintenance, a total of \$112,996.17.

Effect of improvement.—The completion of the project has effected a marked increase in the amount of commerce, the increase in tonnage for the last three years being approximately 75 per cent. It is believed that the project has some effect in controlling freight rates.

Proposed operations.—The following is a statement of the work proposed to be done with the funds now available:

Operation of U. S. dipper dredge <i>Kewaunee</i> , seasons of 1917 and 1918—	\$2, 000. 00
Rebuilding in wood with concrete superstructure 450	
linear feet north revetment (in front of United States	
property) season of 1917, at \$20 per foot-----	\$9, 000. 00
Less material on hand -----	3, 195. 32
	<u>5, 804. 68</u>
Engineering and contingencies-----	1, 133. 28
Total -----	<u>8, 937. 96</u>

Dredging for maintenance of channel will be required. Additional stone is required for filling pockets in harbor piers. The following

estimate of work proposed to be done prior to June 30, 1918, in addition to work to be done with the funds now available, is submitted:

Operation of U. S. dipper dredge <i>Kewaunee</i> one-fourth month, at \$4,000__	\$1, 000
750 tons of stone for pier filling, at \$1.50_____	1, 125
Engineering and contingencies_____	375
Total _____	2, 500

Commercial statistics.—The general character of the commerce for the current year is coal, grain, fish, lumber, and stone. The usual limit of draft of vessels is 14.5 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	27, 283	\$136, 725
1914.....	38, 579	169, 043
1915.....	47, 897	198, 596

Amount expended on all projects from Mar. 3, 1871, to June 30, 1916:	
New work _____	\$268, 059. 40
Maintenance _____	92, 550. 12
Total _____	360, 609. 52
Balance available for fiscal year ending June 30, 1917_____	8, 937. 96
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement_____	2, 500. 00

MANITOWOC HARBOR, WIS.

Location and description.—This harbor is on the west shore of Lake Michigan, distant about 76 miles northerly from Milwaukee and about 102 miles from Green Bay via Sturgeon Bay Canal. It is located at the mouth of the Manitowoc River and is formed by inclosing a portion of Lake Michigan within breakwaters, forming a basin having an area of about 78 acres. The commercial harbor is located within the Manitowoc River, which has been dredged and is maintained by the municipality.

Existing project.—The existing project, adopted by the river and harbor act of March 2, 1907, provides for the reconstruction of the harbor in accordance with report submitted in House Document No. 62, Fifty-ninth Congress, first session, as modified by the Board of Engineers for Rivers and Harbors; estimated cost, \$486,000.

The present complete plan of improvement provides for an exterior basin protected by two converging breakwaters extending from the shore, the north breakwater 2,540 feet long, the south breakwater 2,290 feet long, and consists of piling, concrete, caissons, and timber cribs; and a channel 2,000 feet long, 500 feet wide, and 20 feet deep through the basin, extending from the mouth of the river to deep water in Lake Michigan. The plane of reference is 581.63 feet above mean tide at New York City, being the mean level of Lake Michigan for the years 1860–1875. For latest published map see House Document No. 136, Sixty-third Congress, first session.

Condition at the end of fiscal year.—The approved project was completed during the fiscal year ending June 30, 1911, for \$28,783.69

less than the estimate, the amount expended on new work and maintenance to that time being \$440,080.85. The controlling depth at the end of the fiscal year is 20 feet at the project plane of reference. The south crib breakwater is in good condition; the north crib breakwater is beginning to show considerable decay. The concrete caissons are in fair condition. The north pile pier connecting the caissons with shore shows considerable decay. The south pile pier is in good condition. Many of the pockets in the cribs and pile piers are partially empty and need refilling with stone. The expenditures under existing project were \$234,248.48 for improvement, \$224,199.41 for maintenance; a total of \$458,447.89.

Effect of improvement.—The principal effect has been to increase the volume of car-ferry business and of coal receipts for shipment to the interior.

Proposed operations.—The following is a statement of the work proposed to be done with the funds now available:

Operation of U. S. dipper dredge <i>Kewaunee</i> , one-half month (June, 1917), at \$4,000	\$2, 000. 00
750 tons stone for pier filling (June, 1917), at \$1.50	1, 125. 00
Engineering and contingencies	573. 04
Total	3, 698. 04

No extensive repairs to the piers are immediately needed. Additional stone for filling and riprap is, however, required. The following estimate of the work proposed to be done prior to June 30, 1918, in addition to the work to be done with funds now available, is submitted:

1,500 tons stone, at \$1.50	\$2, 250
Minor repairs to piers	500
Engineering and contingencies	250
Total	3, 000

Commercial statistics.—The general character of the commerce for the current year is aluminum ware, grain, flour, pig copper, lumber, coal, manufactured iron, and miscellaneous freight. The usual limit of draft of car ferries is 16 feet; coal and grain carrying vessels, 19 feet; other vessels, 15 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	1, 901, 065	\$72, 805, 380
1914.....	1, 742, 860	106, 412, 333
1915.....	1, 586, 808	58, 507, 281

Amount expended on all projects from Aug. 20, 1852, to June 30, 1916:

New work	\$634, 595. 12
Maintenance	278, 519. 56
Total	913, 114. 68
July 1, 1916, balance unexpended	3, 698. 04
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	3, 000. 00

SHEBOYGAN HARBOR, WIS.

Location and description.—This harbor is on the west shore of Lake Michigan, distant about 24 miles south from Manitowoc and about 52 miles north of Milwaukee. It is located at the mouth of the Sheboygan River and is formed by inclosing a portion of Lake Michigan within breakwaters, forming a basin having an area of about 102 acres. The commercial harbor is located within the Sheboygan River, which has been dredged and is maintained by the municipality.

Existing project.—The existing project, adopted by the river and harbor act of March 2, 1907, provides for extension of the north breakwater, for a south breakwater, and for subsequent necessary extensions to each breakwater in general accordance with type plan as set forth in report submitted in House Document No. 62, Fifty-ninth Congress, first session.

In Annual Report for 1911, page 1967, a tentative plan of improvement was published, the estimated cost being \$998,000. It was recommended, however, that the work in the immediate future be confined to extending the north breakwater shoreward, postponing the construction of a south breakwater until its necessity should be more fully demonstrated. The estimated cost of this partial improvement is \$362,000.

The present plan of improvement provides for an exterior basin protected on the north by a breakwater, about 3,900 feet long, consisting of timber cribs, concrete caissons, and piling, extending to the shore, and on the south by a crib and pile pier about 2,750 feet long; and a channel about 3,000 feet long, 360 feet wide, and 21 feet deep through the basin, extending from the river mouth to deep water in Lake Michigan, and protected on the north side at river mouth by a pile pier and revetment about 570 feet long. The plane of reference is 581.63 feet above mean tide at New York City, being the mean level of Lake Michigan for the years 1860–1875. For latest published map, see Annual Report for 1909, opposite page 1968.

Condition at the end of fiscal year.—The partial project providing for construction of north breakwater and removal of old north pier and dredging was completed during the fiscal year. The controlling depth at the end of the fiscal year is 21 feet at the project plane of reference. The north breakwater is in good condition, except the riprap around the older portion, which consists of timber cribs, has settled. Portions of the south pier are in poor condition, but it is believed no extensive repairs should be made pending the determination as to necessity of a south breakwater. The remaining portion of the north pier at the shore and the revetment in front of the Government property are very dilapidated. The expenditures under existing project are \$374,441.07 for improvement and \$65,650.33 for maintenance; total \$440,091.40.

Effect of improvement.—The principal effect has been a marked stilling effect of the water in the river, with increased safety for vessels moored in the lower portion of the Sheboygan River. It is believed that the project has a material effect in controlling freight rates, both locally and for transshipment.

Proposed operations.—The following is a statement of the work proposed to be done with the funds now available:

Operation of U. S. dipper dredge <i>Kewaunee</i> , one-half month (June 1917, and June, 1918), at \$4,000-----	\$2, 000. 00
Rebuilding 250 linear feet of superstructure in concrete on north stub pier (June and July, 1917), at \$16-----	4, 000. 00
Rebuilding 250 linear feet of superstructure in concrete on revetment in front of United States property (June and July, 1917), at \$10---	2, 500. 00
1,500 tons stone for additional riprap around breakwater and filling pockets of south pier (August, 1916), at \$1.50-----	2, 250. 00
Engineering and contingencies-----	1, 107. 72
Total-----	11, 857. 72

Additional stone is needed for riprap along the breakwater, especially the older portion, consisting of timber cribs. The following estimate for work proposed to be done prior to June 30, 1918, in addition to work proposed to be done with funds available, is submitted:

4,000 tons stone riprap along breakwater for 800 linear feet of crib section, at \$1.50-----	\$6, 000
Engineering and contingencies-----	600
Total-----	6, 600

The average cost of maintenance for past three years is \$4,306.24. The excess amount requested for maintenance is due to stone required to bring riprap of breakwater up to necessary height. During the past three years but little riprap was deposited.

Commercial statistics.—The general character of the commerce for the current year is furniture, leather, coal, groceries, and general merchandise.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	761, 971	\$7, 262, 386
1914.....	637, 679	9, 331, 213
1915.....	665, 502	9, 592, 218

Amount expended on all projects from June 23, 1856, to June 30, 1916:

New work-----	\$862, 257. 71
Maintenance-----	152, 933. 13
Total-----	1, 015, 190. 84
July 1, 1916, balance available-----	11, 857. 72
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	6, 600. 00

MILWAUKEE HARBOR, WIS., INCLUDING HARBOR OF REFUGE.

Location and description.—This harbor is on the west shore of Lake Michigan, distant about 85 miles northerly from Chicago and about 85 miles west of Grand Haven, Mich. It is located at the mouth of the Milwaukee River and consists of a channel about 1,650 feet long, extending from deep water in Lake Michigan to the mouth of the river and protected by piers 360 feet apart at outer end and

545 feet apart at the shore end. The commercial harbor is in the Milwaukee, Menomonee, and Kinnikinnic Rivers and has been dredged and maintained by the municipality. The harbor of refuge is formed by inclosing a portion of Lake Michigan by a breakwater extending from the shore in a generally southeasterly direction a distance of about 8,610 feet, providing a basin of about 650 acres, over 275 acres of which there is a depth of 18 feet and greater.

Existing project.—The existing project, adopted by the river and harbor act of March 2, 1907, without prior survey or estimate, provides for “an extension of one thousand feet to and the repair and rebuilding of the breakwater belonging to the harbor of refuge, and the rebuilding of the south pier of the harbor entrance”; estimated cost \$592,000.

The present complete plan of improvement provides for a breakwater 8,610 feet long consisting of timber cribs, of which 7,630 feet is provided with concrete superstructure; and a channel 1,700 feet long, average width 200 feet, and 21 feet deep, extending from the mouth of the Milwaukee River to deep water in Lake Michigan, protected by two piers, the north pier consisting of timber cribs and the south pier of concrete caissons and piling, both piers provided with concrete superstructure. The plane of reference is 581.63 above mean tide at New York City, being the mean level of Lake Michigan for the years 1860–1875. For latest published map see Annual Report for 1911, opposite page 2332.

Condition at the end of fiscal year.—The project was completed during the fiscal year ending June 30, 1911, except for maintenance of channel and existing works. The controlling depth at the close of the fiscal year was 21 feet at the project plane of reference. The piers and breakwater are generally in good condition except that a considerable amount of riprap is needed around the breakwater. The expenditures under existing project were \$105,848.98 for improvement and \$541,231.52 for maintenance, a total of \$647,080.50.

Effect of improvement.—The harbor of refuge is but little used by vessels seeking shelter from storms, but on account of the congested condition of the inner harbor it is largely used by vessels waiting an opportunity to enter the inner harbor and proceed to their destination. There is no record of the number of vessels which have moored in the harbor of refuge. By reason of its excellent harbor, Milwaukee has become the principal coal-receiving port on Lake Michigan. Many bulky articles, such as coal, salt, sugar, etc., are transshipped from water to rail at Milwaukee. The favorable effect of the harbor upon commerce is widespread throughout several States lying to the westward.

Proposed operations.—The following is a statement of the work proposed to be done with the funds now available:

Operation of U. S. dipper dredge <i>Kewaunee</i> , season of 1918-----	\$1, 000. 00
Depositing 8,600 tons riprap along breakwater, season of 1917, at \$1.50-----	12, 900. 00
Engineering and contingencies-----	1, 437. 94
Total-----	15, 337. 94

A considerable amount of stone will be still needed for riprap. Soundings recently taken show that along much of the breakwater the riprap is nearly to the bottom of the cribs. It is proposed to

replenish the riprap to a height of 12 feet below the datum plane. The following estimate of the work proposed to be done prior to June 30, 1918, in addition to the work to be done with the funds now available, is submitted:

12,900 tons stone for riprap at breakwater, at \$150_____	\$19,350
Engineering and contingencies_____	2,150
Total _____	21,500

The average cost of maintenance for the past three years is \$10,633.06. The excess amount requested for maintenance is due to a large amount of stone required to bring riprap of breakwater up to necessary height. During two of the past three years no riprap stone was deposited.

Commercial statistics.—The general character of the commerce for the current year is grain, coal, flour, mill feed, lumber, manufactured iron, sugar, and unclassified freight.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	8,647,230	\$140,734,750
1914.....	8,484,829	152,870,899
1915.....	8,119,875	150,348,921

Amount expended on all projects from Mar. 3, 1843, to June 30, 1916:

New work_____	\$1,385,465.17
Maintenance_____	1,000,656.21
Total_____	2,386,121.38

Balance available for fiscal year ending June 30, 1917_____	15,337.94
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement_____	21,500.00

KENOSHA HARBOR, WIS.

Location and description.—This harbor is on the west shore of Lake Michigan, distant about 33 miles southerly from Milwaukee and about 52 miles northerly from Chicago. It is located at the mouth of Pike Creek, and consists of an interior basin having an area of about 8 acres and a channel extending therefrom to deep water in Lake Michigan. The entrance to channel is protected on the north by a detached breakwater.

Existing project.—The existing project, adopted by the river and harbor act of March 2, 1907, provides for an extension of 200 feet to the landward end of the breakwater; estimated cost, \$42,000. (H. Doc. No. 62, 59th Cong., 1st sess.)

The present complete plan of improvement provides for a timber-crib breakwater 800 feet long and a channel 2,350 feet long, 200 feet wide, 21 feet deep, protected beyond the shore line by parallel pile and crib piers, leading to an interior basin having a depth of 20 feet. The plane of reference is 581.63 feet above mean tide at New York City, being the mean level of Lake Michigan for the years 1860–1875.

For latest published map, see Annual Report for 1903, opposite page 1863.

Condition at the end of fiscal year.—The breakwater extension was completed during the fiscal year ending June 30, 1910, for \$1,446.96 less than the estimate. The controlling depths at the end of the fiscal year are 21 feet in the channel and 20 feet over about one-half the basin at the project plane of reference. With the completion of the rebuilding of the superstructure on north pier the piers and breakwater will be in good condition, except for a small amount of stone needed for filling pockets of cribs. The expenditures under existing project are \$40,553.04 for improvement and \$80,463.21 for maintenance, a total of \$121,016.25.

Effect of improvement.—The extension of the breakwater has somewhat diminished disturbances in the harbor during storms. It is believed that the project has a considerable effect in controlling freight rates not only on coal for local consumption brought in by way of the harbor but also by affording Kenosha rail rates accorded places at which water competition exists.

Proposed operations.—The following is a statement of the work proposed to be done with the funds now available:

Operation of U. S. dipper dredge <i>Kewaunee</i> , one-half month (May, 1917), at \$4,000	\$2, 000. 00
Concrete superstructure on north pier (September, 1916)	8, 100. 00
750 tons stone for riprap around breakwater, at \$1.50 (September, 1916)	1, 125. 00
Engineering and contingencies	1, 198. 99
Total	12, 423. 99

The following estimate for work proposed to be done prior to June 30, 1918, in addition to the work to be done with funds now available, is submitted:

Operation of U. S. dipper dredge <i>Kewaunee</i> , one-half month, at \$4,000	\$2, 000
750 tons stone for crib filling, at \$1.50	1, 125
Engineering and contingencies	375
Total	3, 500

Commercial statistics.—The general character of the commerce for the current year is leather, brass castings, coal, fish, and package freight.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.	85,743	\$4,577,300
1914.	78,641	4,259,746
1915.	73,268	7,950,859

Amount expended on all projects from Aug. 30, 1852, to June 30, 1916:	
New work	\$494, 392. 53
Maintenance	102, 439. 09
Total	596, 831. 62
July 1, 1916, balance available	12, 423. 99
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	3, 500. 00

HARBOR AT DULUTH, MINN., AND SUPERIOR, WIS.

Location and description.—This harbor is at the extreme western end of Lake Superior, a distance of 395 miles from its outlet at Sault Ste. Marie, Mich. The cities of Duluth, Minn., and Superior, Wis., are situated on the north and south sides, respectively. Superior Bay and its tributaries, St. Louis Bay and St. Louis River, together with Allouez Bay and the mouth of Nemadji River at the south, or Wisconsin end of Superior Bay, form Duluth-Superior Harbor. It has 49 miles of harbor frontage and 17 miles of dredged channels, all of which lie behind Minnesota Point, a natural break-water 8 miles long.

Existing project.—The existing project provides for rebuilding at the Duluth and Superior entrances the piers with concrete superstructure and stone-filled cribs and for securing channels of varying widths from 100 to 600 feet and a uniform depth of 20 feet below low-water datum throughout the harbor, with such additional depths in the basins, entrances, and the lake approach to the entrances as may be necessary to insure the existence of the project depth under all conditions of weather. The legal plane of reference for this harbor is 601.64 feet above mean tide at New York. This consolidated project was adopted by the river and harbor act of June 3, 1896, in accordance with the report printed in House Executive Document No. 59, Fifty-third Congress, third session, at an estimated cost (for dredging alone) of \$3,130,553. The law provided, however, that the project could be modified in the interests of commerce as the Secretary of War might direct, but without increasing the estimated cost. Under this provision the Secretary of War on May 9, 1901, authorized the omission of dredging the Minnesota Point Channel, reducing the limits of dredging in the St. Louis River as originally projected, the shortening of the Allouez Bay Channel, and reducing the width of the Twenty-first Avenue Channel in St. Louis Bay from 200 to 100 feet. Additions to this project have been authorized as follows: By the river and harbor act approved June 13, 1902, to cover rebuilding the piers at the Superior entry at an increase in cost of \$650,000. By the river and harbor act approved March 2, 1907, to provide for the enlargement of the plan for the Superior entry, in accordance with the report printed in House Document No. 82, Fifty-ninth Congress, second session, at an estimated cost of \$1,703,000, by means of widening the entrance to 500 feet and dredging to a depth of 24 feet between the concrete revetments which extend only to the shore line; this entrance to be protected by converging breakwaters of rubble-mound construction with concrete pierheads on stone-filled cribs, and concrete shore revetments, whose lake ends should be located at the 30-foot contour in prolongation of the entrance channel 600 feet apart and diverging until they are 2,100 feet apart at the shore line, the space between these piers and the shore to be dredged to form a stilling basin with a central channel between the pierheads and the revetted entrance 600 feet wide and 30 feet deep, the bay channel just within the entrance to be widened on the north side; also to include additional dredging near the draw span of the Northern Pacific Railroad bridge, at an estimated cost of \$55,500. By section 4 of the administrative act approved May 28,

1908, to include dredging an additional area for the basin inside the Duluth entrance to a depth of 22 feet, as recommended in House Document No. 221, Sixtieth Congress, first session; estimated cost \$550,800, later increased to \$672,000. By the river and harbor act approved July 27, 1916, for continuing improvement by enlarging the Superior Harbor basin in accordance with the report printed in House Document No. 651, Sixty-fourth Congress, first session, at an estimated cost of \$360,000 with an estimated annual cost of \$3,000 for maintenance and administration. The total estimated cost of this project and all its modifications is \$6,571,053. No estimate for maintenance submitted, except that of \$3,000 for the last addition to the project and its modifications. For latest published map of this harbor see Annual Report for 1903, page 1808.

Condition at the end of fiscal year.—With the exception of the enlargement of the Superior Harbor Basin authorized by the river and harbor act of July 27, 1916, the existing project is regarded as completed, and the following has been accomplished: Seventeen miles of channels dredged to a depth of 20 feet below low-water datum, with a width of from 100 to 600 feet, with turning basins at channel junctions, completed in 1902; new canal piers of concrete on stone-filled cribs founded on piles aggregating 3,468 feet in length, completed in 1901; concrete park and sea walls built and parks filled to grade at the Duluth Canal, an engineer building for offices and watchmen accommodations built in the north canal park, completed in 1906; a vessel yard with proper slip, pier, warehouse, boathouse, and watchman quarters, constructed on United States lands on Minnesota Point near the Duluth Canal, completed in 1904. Duluth Harbor Basin, with an area of 446 acres, with 20 feet depth, completed in 1915; the approach to Duluth entrance dredged to 30 feet below low-water datum and the canal deepened to 24 feet, completed in 1907; at Superior entry the canal all-concrete revetments, widening the canal to 500 feet and aggregating 3,696 feet in length, completed in 1909; lake approach to canal entrance deepened to 30 feet and canal to 24 feet, completed in 1909; converging breakwaters comprising 4,205 linear feet of rubble mound, 900 linear feet of stone-filled crib and concrete superstructure, pierheads founded on piles and 896 linear feet of concrete shore revetments on pile foundations, all completed in 1912; all revetments are riprapped; Superior entry stilling basin, with an area of 35 acres, completed in 1915; Superior Harbor Basin, with an area of 98 acres, completed in 1914—work on the enlargement of this basin has not yet been begun.

The maximum draft that can be carried in this harbor and up the St. Louis River to a point opposite the southerly end of Big Island is 20 feet at low-water datum. Total expenditure under existing project to close of fiscal year, not including outstanding liabilities for new work, are \$5,231,551.67; for maintenance, \$817,795.26; total, \$6,049,346.93. The work done has been completed for \$979,501.33 less than the approved estimate.

Local cooperation.—Congress, by the river and harbor act of August 18, 1894, authorized the Secretary of War to accept donations of land for the Duluth Canal site. The city of Duluth donated lands for that purpose which cost the city \$12,237.04; acceptance was made by the Secretary of War July 12, 1897. The following work has been

done for the benefit of the public with funds supplied by other sources than Congress:

In 1870 the Lake Superior & Mississippi Railway Co. built 400 linear feet of outer breakwater at Duluth. Estimated cost, \$50,000.

In 1870 the city of Duluth and Northern Pacific Railway Co. conjointly expended \$43,791.84 in cutting Duluth Ship Canal through Minnesota Point.

In 1871 and 1872 the city of Duluth built 4,490 linear feet of dike across Superior Bay at a cost of \$76,404.38.

No conditions were imposed by law and there was no cooperation other than stated.

Effect of improvement.—The effect of the work done under the existing and previous projects has been to facilitate navigation by means of deeper and wider channels, with commodious anchorage and turning basins and safe entrances to the harbor, as well as to give refuge to vessels seeking shelter from storms. Through these improvements, which permit the use of larger vessels, water rates have been reduced and railroad rates have also been materially reduced.

Proposed operations.—The available balance for maintenance, amounting to \$68,510.13, will be expended as follows:

Repairs to breakwaters and piers, for purchase of rock-----	\$5,000.00
Shore riprap at end of north breakwater at Superior entry-----	1,500.00
Operation of one steamer, floating derrick, pile driver, and scow (in part) in handling stone, removing sand from rear of south canal revetment at Superior entry, riprapping canal piers at Superior entry-----	8,000.00
Operation of dredging plant consisting of one dipper dredge, steam tug, and three scows (in part) for dredging shoals in Superior Harbor Basin canal and inner channel, dredging shoals in south channel, St. Louis Bay-----	34,000.00
Operation of harbor patrol-----	5,000.00
Maintenance of buildings, vessel yard, docks, and grounds-----	3,000.00
Administration and contingencies-----	12,010.13

It is expected that the maintenance funds will be exhausted by June 30, 1917.

The appropriation of \$180,000 will be expended in dredging as much of the Superior Anchorage Basin in 1917 as the funds will permit, and to complete the remainder of the basin as fast as funds are provided by law. Work will begin late this fall or at the opening of navigation in the spring of 1917. The balance of \$180,000 should be appropriated in the next sundry civil bill.

Additional funds will be required for maintenance for the fiscal year ending June 30, 1918, and an estimate of \$45,000 is submitted.

Repairs to breakwaters and piers-----	\$3,000
Operation of one steamer, floating derrick, pile driver, and scow (in part)-----	5,000
Operations of dredging plant, consisting of one dipper dredge, steam tug, and three scows (in part)-----	18,000
Operation of harbor patrol-----	7,000
Maintenance of buildings, vessel yard, dock, and grounds-----	5,200
Administration and contingencies-----	6,800
Total-----	45,000

Commercial statistics.—In value receipts consist principally of coal, general merchandise, and oils; shipments consist principally of iron ore, grains, copper, and lumber.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	46,875,416	\$352,595,577
1914.....	33,535,704	287,002,960
1915.....	40,494,672	368,802,154

With deeper channels and commodious anchorage basins the tendency has been to increase the dimensions of vessels and weight of cargoes. All classes of vessels doing business at Duluth-Superior Harbor make use of the Government improvements, but a very small proportion (possibly not more than one-tenth of 1 per cent) could carry on their business without the aid of the present improvements. The iron ore, coal, grain, and a part of the package freight business was carried on by boats drawing 18 to 20 feet of water and representing 86.71 per cent of the total tonnage of the harbor entering and departing in 1915; the lumber, passenger, and the balance of the package business was carried on by vessels drawing 12 to 15 feet of water and representing 9.03 per cent of the total tonnage.

Amount expended on all projects from March 2, 1867, to June 30, 1916:

New work	\$6, 778, 746. 67
Maintenance	817, 795. 26
Total	7, 596, 541. 93
Balance available for fiscal year ending June 30, 1917.....	248, 510. 13
Amount (estimated) required to be appropriated for completion of existing project.....	180, 000. 00

Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement (sundry civil bill).....	180, 000. 00
For maintenance of improvement.....	45, 000. 00
Total	225, 000. 00

DULUTH-SUPERIOR HARBOR, MINN. AND WIS.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1018, Sixty-fourth Congress, first session:

The consolidated project for improvement of Duluth-Superior Harbor was adopted by the river and harbor act of June 3, 1896, and with its subsequent modifications is estimated to cost \$6,211,053. The district officer states that the present project is adapted to the locality, but for reasons given he believes that it should be enlarged slightly to include dredging of a shoal point which projects into the southerly end of the East Gate Basin. This shoal embraces an area of 10.6 acres, and the cost of removing it to a depth of 22 feet below low-water datum is estimated at \$24,000, with \$500 per annum for maintenance.

I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore recommend legislation modifying the existing project for improvement of Duluth-Superior Harbor, Minn. and Wis., to include the dredging of the shoal point in the southerly end of the East Gate Basin, to a depth of 22 feet below mean low water, as proposed by the district officer, at an estimated cost of \$24,000 for original work and \$500 annually for maintenance.

WARROAD HARBOR AND WARROAD RIVER, MINN.

Location and description.—Warroad Harbor and Warroad River are at the southwestern extremity of Lake of the Woods, 36 miles

west of the mouth of Rainy River. Warroad Harbor is about 1 mile long, varies in width from 550 feet to 1,300 feet, and is formed in the mouth of Warroad River which in itself is a very small stream.

Existing project.—Dredging and maintaining a channel 8 feet deep at mean low water from the landing at Warroad to deep water in the lake, the channel being 9,200 feet long and 200 feet wide within the harbor and 300 feet wide out in the lake, with a turning basin 500 by 900 feet at the inner end. Also a pile-brush-stone jetty on the north side of the channel, extending from the shore 700 feet into the lake. The level of the Lake of the Woods being artificially controlled and not properly regulated in the past, its mean level is subject to determination by the International Joint Commission, which now has the matter under consideration. Until a decision is arrived at, mean low water is assumed to be 4 feet on the Warroad gauge. The existing project was adopted by the river and harbor act of March 3, 1899, and modified by the following river and harbor acts: June 6, 1900; June 13, 1902 (H. Doc. No. 92, 56th Cong., 2d sess.); March 3, 1905; June 25, 1910 (H. Doc. No. 703, 61st Cong., 2d sess.), and July 25, 1912. The approved modified estimate of cost is \$98,700 and \$2,000 annually for maintenance. The latest published map is opposite page 1984 in the Annual Report for 1911.

Condition at the end of fiscal year.—The improvement has resulted in giving a 6-foot increase in depth over the bar at the mouth of Warroad River. The protective jetty was completed in fiscal year 1910 and the turning basin at the Warroad wharves was completed in 1911. The dredged channel was completed in fiscal year 1915 to a width of 200 feet and a depth of 8 feet at mean low water. The material removed from the channel and turning basin was 694,201 cubic yards of muskeg, mud, rock, sand, clay, and hardpan. The existing project provides for a width of 300 feet in that part of the channel which lies out in the lake, but the width of 200 feet already obtained has proved sufficient for all present needs. The controlling depth in the channel on June 30 is 10.9 feet, the stage of lake being 6.4 feet above assumed low water, and the channel of project depth of 8 feet having shoaled to 4.5 feet. The total expenditures to the end of the fiscal year were \$83,805.36 for new work and \$33,817.15 for maintenance, a total of \$117,622.51.

Effect of improvement.—The improvement has made it possible for all boats on the Lake of the Woods to enter Warroad Harbor with ease and safety, and provides shelter in time of storm. It also permits the transfer of freight between rail and water at the only American port on the lake. The improvement has had no effect on rail rates.

Proposed operations.—The available funds will be expended in dredging and caring for dredge *Warroad* and fleet and making a hydrographic survey of the dredged channel, as follows:

Dredging-----	\$1, 000. 00
Care and repair of plant-----	650. 00
Hydrographic survey-----	150. 00
Administration and contingencies-----	464. 19
Total-----	<hr/> 2, 264. 19

Present funds will probably be exhausted by July 1, 1917.

Dredging in the channel is required annually to remove material constantly being deposited by the action of wind and current. The amount estimated for the fiscal year ending June 30, 1918, will be for maintenance.

Operation of dredge <i>Warroad</i> 1.5 months, at \$600-----	\$900
Care and repair of dredging plant-----	630
Hydrographic survey-----	150
Administration and contingencies-----	320
Total-----	2,000

Commercial statistics.—The commerce for Warroad Harbor is mainly fish and timber products brought in for shipment by rail, miscellaneous supplies outbound for the fishery stations, and transportation of passengers. The usual draft limit for all loaded boats is 7 feet.

Comparative statement.

Calendar year.	Short tons.	Value.	Passengers.
1913.....	12,265	\$355,100	12,000
1914.....	53,785	493,320	10,495
1915.....	12,290	373,120	10,250

Amount expended on all projects from March 3, 1899, to June 30, 1916:

New work-----	\$83,805.36
Maintenance-----	33,817.15
Total-----	117,622.51

Balance available for fiscal year ending June 30, 1917-----	2,264.19
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	2,000.00

ZIPPEL BAY, LAKE OF THE WOODS, MINN.

Location and description.—Zippel Bay is situated on the southern shore of Lake of the Woods, about 26 miles by water east of Warroad Harbor and about 10 miles west of the mouth of Rainy River.

Existing project.—The existing project was adopted by the river and harbor act of February 27, 1911 (H. Doc. No. 1276, 61st Cong., 3d sess., with map), and contemplates dredging and maintaining a channel through the dry bar between the lake and the harbor in the bay 3,000 feet long, 200 feet wide, and 9 to 10 feet deep at mean controlled lake stage (7.2 feet on the Warroad gauge), and a pile-brush-stone jetty 2,800 feet long at the lake end of the dredged channel. The main object of the improvement is to provide a harbor of refuge on the south shore of the lake, with incidental benefit to local commerce. The approved estimate of cost is \$27,781 and \$1,000 annually for maintenance.

Condition at the end of fiscal year.—The work accomplished has been the dredging of a channel 3,000 feet long, 200 feet wide, and 10 feet deep at mean controlled lake stage, together with the construction of a pile-brush-stone jetty 2,200 feet long. This work has

resulted in providing a suitable harbor of refuge and increasing the depth of the entrance channel 5 feet and the width 100 feet. The portion completed in 1914 being sufficient for present needs of navigation, 600 feet of the project length of the jetty was not built. The dredging was completed in 1913. The controlling depth at the end of the fiscal year was 9 feet, the minimum project depth at mean controlled lake stage. The total expenditures to the end of the fiscal year were \$30,419.98, of which \$27,940.86 was for new work and \$2,479.12 for maintenance.

Effect of improvement.—The improvement has provided a safe and commodious entrance into Zippel Bay as a harbor of refuge and has benefited local commerce. No records are available of the extent to which the harbor has been used for shelter. The improvement has had no effect on freight rates, there being no railroad near Zippel.

Proposed operations.—The available funds are to be expended in making repairs to the jetty and making a hydrographic survey of the channel, the work to be done during the winter. The funds will probably be exhausted prior to April 1, 1917.

Repairs to jetty	\$700. 00
Hydrographic survey of harbor.....	150. 00
Administration, care of plant, and contingencies.....	500. 52
Total	1, 350. 52

The existing high stage of water in Lake of the Woods will probably continue for some time, and will make it necessary to repair and strengthen the jetty, which is now subject to heavy seas. The amount estimated for expenditure during the fiscal year ending June 30, 1918, will be for repairing the jetty:

400 tons rock at 60 cents.....	\$240
300 cords brush at \$1.50.....	450
Administration and contingencies.....	310
Total	1, 000

Commercial statistics.—The commerce for Zippel Bay is fish, fishery supplies, timber products, miscellaneous freight, and the transportation of passengers. The usual draft limit for all loaded boats is 7 feet.

Comparative statement.

Calendar year.	Short tons.	Value.	Passengers.
1913.....	8, 830	\$138, 400	1, 780
1914.....	52, 923	323, 080	825
1915.....	775	81, 500	2, 540

Amount expended on all projects from February 27, 1911, to June 30, 1916:

New work.....	\$27, 940. 86
Maintenance	2, 479. 12
Total.....	30, 419. 98

Balance available for fiscal year ending June 30, 1917.....	1, 350. 52
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	1,000. 00

BAUDETTE HARBOR AND RIVER, MINN.—NEW PROJECT.

Report of the Chief of Engineers printed in House Document No. 109, Sixty-third Congress, first session:

The Baudette River rises in the swamp land of northern Minnesota, about 25 miles north of Red Lake, flows in a northeasterly direction, and enters the Rainy River 10 miles above the point where that stream empties into the Lake of the Woods. Below the mouth of the Baudette River Rainy River has a channel depth of 8 feet or more at low water. Navigation of this system of waterways is confined to the Lake of the Woods and its tributaries. Baudette River, from its source for a distance of about 30 miles to within a mile of its mouth, is a comparatively insignificant stream, but at this point it broadens out, and for the remainder of its course varies from 400 to 1,000 feet in width. Located on the east and west banks, respectively, at the point of juncture with the Rainy River, are the towns of Spooner and Baudette. The principal landings are on Baudette River just above the mouth, and, for reasons stated by the district officer, it does not appear practicable to maintain village docks on the banks of the Rainy River. A small channel has been dredged to the wharves at local expense, but this channel proved inadequate and soon deteriorated, and local interests now seek Government aid to provide a harbor adequate to their growing needs. The district officer estimates that a channel 75 feet wide and $8\frac{1}{2}$ feet deep at assumed low water, with a turning basin between the two wharves, will cost \$2,750, and \$300 annually for maintenance. He is of opinion that the locality is worthy of improvement by the General Government, and recommends the adoption of the project outlined above. In this view the division engineer concurs.

I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore, in carrying out the instructions of Congress, I report as follows: That the improvement by the United States of Baudette Harbor and River, Minn., is deemed advisable so far as to secure an available channel depth of $8\frac{1}{2}$ feet and a channel width of 75 feet, increased at entrances and on curves, with a turning basin as shown on accompanying map, following in general the methods described in the report of the district officer, at an estimated cost of \$2,750 for first construction and \$300 annually for maintenance.

The boats navigating Rainy River transact the business of Spooner and Baudette. During 1911, 4 steamers and 25 launches entered Baudette Harbor on regular trips, carrying 94,710 passengers and 71,178 tons of miscellaneous freight. Besides this commerce, there was a large tonnage in logs, square timber, poles, and piling.

HARBOR AT AGATE BAY, MINN.

Location and description.—The harbor is situated on the north shore of Lake Superior, 27 miles northeast from Duluth, Minn.

Existing project.—The project contemplates the narrowing of the natural entrance, thus affording protection from southwest storms and reverse swells from northeast storms, by the construction of breakwaters extending from the east and west points of the bay; also a small amount of dredging. The plane of reference, called low-water datum, is 601.75 feet above mean tide at New York. The breakwaters are to be composed of rock-filled timber cribs resting on rubble-mound embankments. The cost was estimated at \$160,000 for an east breakwater only and the dredging. (H. Ex. Doc. No. 94, 48th Cong., 2d sess.) The project was adopted by the river and harbor act of August 5, 1886. On January 4, 1887, the Secretary of War approved a revision of the project which provided for the construction of two breakwater piers on a line toward each other from the eastern and western points of the bay, 1,000 and 900 feet long, respectively, at an estimated cost of \$213,000. This estimate was

later increased to \$244,208 (Annual Report for 1887, p. 1952), with an estimate of \$2,000 annually for maintenance after completion. (See map, Annual Report for 1903, p. 1793.)

Condition at the end of fiscal year.—Two breakwaters extending from the east and west points of the bay, composed of rock-filled timber cribs resting on rubble-mound embankments were constructed. These breakwaters fulfill very effectively the purpose for which they were designed. The west breakwater is 900 feet long and the east breakwater 1,050 feet. The harbor thus protected has an area of 109 acres. No deterioration has taken place aside from natural decay of timber in superstructure, wear from ice, and damage from collision by vessels. Vessels drawing 20 feet of water can safely navigate the harbor to the ore docks. The depth at the entrance is over 50 feet. The total expenditures under the existing project up to the end of the fiscal year, not including outstanding liabilities, was \$234,057.53 for improvement and \$28,298.77 for maintenance, a total of \$262,356.30. The approved project for improvement was completed at a cost of \$10,150.47 less than the estimate. The project was completed November 1, 1901.

Effect of improvement.—The Government improvements have been an indispensable aid to the commerce. The harbor is used as a refuge by the smaller boats and tugs plying the lake between Duluth and Grand Marais, Minn. No record of the number of boats using it as a refuge is available. All classes of vessels could make use of the harbor without the aid which the Government improvements afford, except in the stormiest weather, but no class could use the harbor in stormy weather without such aid. The draft of water required by vessels laden with iron ore and coal (which constitutes 79.49 per cent of the total commerce) is from 18 to 20 feet. Vessels carrying lumber and all other classes of freight (representing 20.51 per cent of the total) require a depth of 12 to 15 feet of water.

Proposed operations.—The superstructure of the east breakwater is badly decayed and in need of repair. No extensive repairs have been made to this breakwater since 1907, when repairs were made to the easterly 200 feet only. The available funds will be expended for maintenance in making repairs to the piers as follows:

Purchase of timber and rock for repairs.....	\$1, 400. 00
Operation U. S. derrick scow No. 7, and tug, in part.....	1, 400. 00
Administration and contingencies.....	630. 39
Total	3, 430. 39

These funds will be insufficient to make extended repairs, and as the work can be done more economically all at one time an estimate for additional funds for the year ending June 30, 1918, to complete the contemplated repairs is submitted as follows:

Purchase of timber and rock for repairs.....	\$2, 450
Operation of U. S. derrick scow No. 7 and tug.....	2, 400
Administration and contingencies.....	1, 150
Total	6, 000

Commercial statistics.—Receipts consisted of coal, and shipments consisted of iron ore and forest products.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	11,758,009	\$31,758,689
1914.....	6,668,005	16,129,988
1915.....	9,963,107	22,516,664

Amount expended on all projects from August 5, 1886 to June 30, 1916:

New work	\$234,057.53
Maintenance.....	28,298.77

Total.....	262,356.30
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July 1, 1916, balance unexpended.....	3,430.39
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	6,000.00
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INDIANA HARBOR, IND.

Location and description.—Northwestern Indiana (Lake County), on southwest shore of Lake Michigan, 18 miles southeast of Chicago Harbor. This is an entirely artificial harbor, consisting of a channel projected into the lake between piers and carried back into the land by dredging. The entrance is to be protected by a breakwater of the converging arms type now under construction.

Existing project.—There was added to the original project by river and harbor act of March 4, 1913, based on recommendations in House Document No. 690, Sixty-second Congress, second session (with maps), a rubble-mound breakwater, in two arms, 4,950 feet and 2,000 feet long, respectively, each to be extended to the shore if later found necessary. The satisfaction of the Secretary of War with the fulfillment of certain conditions by local interests, upon which the availability of the appropriation was contingent, was expressed on May 1, 1914. The latest published map of this harbor showing the works of previous and existing projects appears opposite page 2936, Annual Report for 1914. The existing project consists of the original project thus modified, and is as follows:

1. Completion and maintenance of outer harbor, 300 feet wide and 22 feet deep, including entrance channel, gradually increasing in width and depth toward lake.

2. Maintenance of inner harbor channel, 20 feet deep, from outer harbor to Lake George and Grand Calumet River, except the removal of sewage and other city refuse, after acceptance from private parties.

3. Construction of rubble-mound breakwater, in two arms, 4,950 and 2,000 feet long, respectively, with shore connections if later found necessary.

The removal of old north pier and the dredging of a new entrance channel 23.5 feet deep (Chicago city datum), 300 feet wide between the piers and 600 feet wide from piers to breakwater, flaring appropriately beyond the breakwater, at a total estimated cost of \$112,000, is considered to be included in the project above stated. The estimate has been increased accordingly. The inner harbor channel is projected to be 3.5 miles long, from the outer harbor to the Grand Calumet, with an arm 1.5 miles long to Lake George. The United

States has accepted as completed and assumed the maintenance of 7,400 feet of the main inner channel and a section 900 feet in length of the extension toward Lake George. Estimated cost (excluding shore connections), \$1,242,200.

Condition at the end of fiscal year.—The general character of the work at this harbor has been dredging and construction of breakwaters. The work of the original project (except maintenance) was completed in 1912 to project dimensions (so-called outer harbor and entrance channel 300 feet wide and 22 feet deep, the latter gradually increasing in width and depth toward the lake). These channels are in good condition. Of the entire estimated quantity of stone required for the breakwater, $14\frac{1}{2}$ per cent have been placed. The maximum draft that can be carried over the shoalest part of this locality, including the accepted portions of the inner channel, is 20 feet, measured from Chicago city datum. Expenditures under existing project have been for new work, \$123,157.41; for maintenance, \$33,585.42; total, \$156,742.83.

Local cooperation.—The river and harbor act of June 25, 1910, which adopted the original project recommended in House Document No. 1113, Sixtieth Congress, second session, imposed the condition that the channel way, owned by private interests, be deeded to and accepted by the United States. This condition was met to the satisfaction of the Secretary of War on October 28, 1910. The river and harbor act of March 4, 1913, which added to the original project a rubble-mound breakwater to protect the harbor entrance, as recommended in House Document No. 690, Sixty-second Congress, second session, contained the proviso "that before construction of breakwater is commenced satisfactory assurance will be given to the Secretary of War that the existing piers will be reconstructed and a suitable public dock or wharves provided by local parties without expense to the United States." The satisfaction of the Secretary of War with the fulfillment of these conditions was expressed on May 1, 1914.

Effect of improvement.—The improvement has provided good water transportation for a large industrial territory that was without such facilities, but the extent of its beneficial influence on freight rates can not be exactly stated. Information from industries located on this waterway indicates that a large water tonnage will develop upon completion of the proposed improvement, which will probably decrease freight rates.

Proposed operations.—It is proposed to apply the funds shown as available in the money statement: (a) Extending rubble-mound breakwater, (b) dredging (maintenance), and (c) supervision.

Probable date of exhaustion of funds December 31, 1917.

The work proposed to be carried on with the funds to be furnished under the estimate submitted is, in order of relative importance: (a) Extending rubble-mound breakwater, (b) dredging (maintenance) and for new entrance channel incident to breakwater construction, and (c) supervision.

Commercial statistics.—The lake commerce for calendar year ending December 31, 1915, is reported as 2,001,374 short tons, consisting of oil, iron ore, coal, and stone, valued at approximately \$14,—

191,028. Following is a statement of the commerce for the last three years:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	875,306	\$9,875,646
1914.....	1,669,455	11,680,013
1915.....	2,001,374	14,191,028

Amount expended on all projects from June 25, 1910, to June 30, 1916:

New work.....	\$183,824.82
Maintenance	36,094.96

Total.....	219,919.78
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Balance available for fiscal year ending June 30, 1917.....	568,460.32
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Amount (estimated) required to be appropriated for completion of existing project.....	395,200.00
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Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement.....	395,200.00
For maintenance of improvement.....	20,000.00

Total.....	415,200.00
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CALUMET HARBOR, ILL.

Location and description.—Northeastern Illinois (Cook County), near the southern end of Lake Michigan, 12½ miles south of Chicago Harbor, and known on the Great Lakes as South Chicago Harbor, it being within the corporate limits of the city of Chicago. A part of the breakwater and of the anchorage area behind same are across the State line in Indiana.

Existing project.—The existing project, based upon a report of the district officer dated February 21, 1896, printed on pages 2584 et seq., Annual Report for 1896, was adopted by river and harbor act of March 3, 1899, and was amended by the Secretary of War on July 11, 1902, under authority contained in river and harbor act of June 13, 1902.

A later project, that for Calumet River, adopted in river and harbor act of 1905, included in the same and by inference removed from the Calumet Harbor project the redredging of Calumet River from the old shore line, where stands the bridge of the Elgin, Joliet & Eastern Railway Co., upward 2 miles. The latest published map of this harbor, showing the works of previous and existing projects, appears opposite page 2930, Annual Report for 1914.

The existing project now provides for—

(a) A breakwater (timber crib) 4,400 feet long, running from the shore due east, together with an extension of the same 2,500 feet long in a southeasterly direction. (River and harbor act of June 13, 1902.)

(b) Deepening of anchorage area (about 366 acres in extent) sheltered by breakwater to 21 feet depth.

(c) Extension of south pier (timber crib) 800 feet.

(d) Deepening Calumet River entrance to 21 feet depth for a width of 200 feet from the lake to the Elgin, Joliet & Eastern Railway Co. bridge near the old shore line (b, c, and d—H. Doc. No. 277, 54th Cong., 1st sess.).

(e) Maintenance.

The estimated cost of work (except maintenance) was \$1,134,830.

Condition at the end of fiscal year.—The general character of the work at this harbor has been dredging, construction of piers and breakwaters. All the work projected at this harbor has been completed except maintenance. The piers and breakwater (completed in 1897 and 1904, respectively) are in good condition, except about 900 linear feet of the superstructure of North Pier (completed in 1883), which is decayed and partly destroyed near the water surface; the entrance channel (completed in 1903) is of project dimensions (300 feet wide and 20 feet navigable depth); and the anchorage area (completed in 1903) has 20 feet navigable depth. Total expenditures under the existing adopted project have been: For new work, \$976,793.62; for maintenance, \$167,543.05; total, \$1,144,336.67.

Effect of improvement.—Transportation by water has been greatly facilitated. This harbor affords cheap freight rates to a large number of industrial plants, elevators, and coal docks, many of which would be put out of business if deprived of the facilities the harbor affords. There is a marked differential in favor of this harbor over Chicago Harbor proper in freights on water-borne commerce, mainly due to congestion and obstructions in Chicago River.

Proposed operations.—It is proposed to apply the funds shown as available in the money statement:

- (a) Dredging entrance to and between harbor piers (maintenance).
- (b) Necessary repairs to piers and breakwater.
- (c) Supervision.

Probable date of exhaustion of funds, July 1, 1917.

The work proposed to be carried on with the funds to be furnished under the estimate submitted is, in order of relative importance:

- (a) Dredging (maintenance).
- (b) Necessary repairs to piers and breakwater.
- (c) Supervision.

Commercial statistics.—The commerce of the calendar year 1915 amounted to 6,968,660 short tons, consisting principally of coal, grain, iron ore, and miscellaneous merchandise, valued approximately at \$135,960,965.

Following is a statement of the commerce through Calumet Harbor for the past three years:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	9,445,878	\$178,817,771
1914.....	6,549,576	162,000,344
1915.....	6,968,660	135,960,965

Amount expended on all projects from July 11, 1870, to June 30, 1916:

New work.....	\$1,431,278.15
Maintenance	167,543.05

Total	1,598,821.20
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Balance available for fiscal year ending June 30, 1917.....	41,139.21
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	15,000.00
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CALUMET HARBOR, ILL.—NEW PROJECT.

Abstract from the reports of the Chief of Engineers and the Board of Engineers printed in House Document 237, Sixty-third Congress, first session:

(For existing project see preceding item.)

All original work of past and existing projects has been completed, leaving only its repair and maintenance.

The district officer states that the entrance channel should be made wider at its outer than at its inner end, where it should be 200 feet wide at surface, 160 feet wide at bottom, and 21 feet deep below Chicago city datum. The proposed widening is estimated to cost \$38,170, and the district officer recommends that the present project be modified to include this work and to omit the section of river extending for a distance of 2 miles above the mouth, which is already included in the project for improvement of Calumet River. The board concurs with the district officer in his recommendation for this harbor.

After due consideration of the above-mentioned reports, I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors that it is advisable for the United States to modify the project for improvement of Calumet Harbor to provide for widening the outer end of the entrance channel, at an estimated cost of \$38,170.

CHICAGO RIVER, ILL.

Location and description.—Cook and Lake Counties, Ill., the navigable portions being wholly in Cook County and the city of Chicago. The main river is formed by the junction of the North and South Branches at a point 0.7 mile west of the Rush Street Bridge, the dividing line between the harbor and river projects. The river flows into Lake Michigan at a point 0.87 mile east of the bridge. The North Branch rises in Lake County and flows southeasterly for about 24 miles; the South Branch rises in the southern part of Cook County and flows northeasterly for about 10 miles. Geographically speaking, it flows into Lake Michigan, but actually it discharges into the Sanitary Canal (the current having been reversed in 1901) at the rate of about 400,000 cubic feet per minute.

Existing project.—Statement of the existing project is as follows: Dredging to 21 feet below hydraulic grade line, corresponding to Chicago city datum in Lake Michigan, from Rush Street Bridge to Ashland Avenue on the West Fork of the South Branch; to the Chicago Junction Railway bridges across the two arms of South Fork; and to Belmont Avenue on the North Branch, including also the canal around Goose Island (North Branch Canal); maintenance of aforementioned channels and of the two turning basins.

The latest published map of this river showing the works of previous and existing projects appears opposite page 2928, Annual Report for 1914. The authorities for the existing project are as follows: River and harbor act of March 3, 1899, adopted 21 feet as the project depth for Chicago River. In the light of this act and of report in House Document No. 95, Fifty-sixth Congress, first session (without map), submitted in accordance with this act, a subsequent act (Mar. 2, 1907), appropriating \$300,000 for improving Chicago River and for maintenance, was interpreted by the Chief of Engineers on April 11, 1908, as adopting the new work of the existing project at an estimated cost of \$810,600, and the terms of the act itself make maintenance a feature of the project.

Condition at the end of fiscal year.—Work done on this river has consisted principally of dredging and the construction of turning basins, 21 feet depth being secured throughout the river and its branches; 2 turning basins 21 feet deep, dredged and revetted; obstructive projections of land in the river removed; and docks built in places to protect new channel, all greatly facilitating navigation. The controlling depth is 21 feet for all months of the year, and the maximum draft that can be carried through the main river and its branches, including North Branch Canal, is 20 feet (Chicago city datum), except at upper end of the North Branch from Diversey Boulevard to Belmont Avenue, a distance of about 0.74 mile, where the mid-channel depth ranges from 15 to 12 feet. All project work was completed in 1914, leaving only maintenance and supervision. The channels are in good condition except as noted above. Total expenditures under present project: For new work, \$543,987.53; for maintenance, \$155,422.21; total, \$699,409.74.

Local cooperation.—In adopting the 21-foot project the river and harbor act of March 3, 1899, prescribed that all the work of removing and reconstructing bridges and piers and lowering tunnels necessary to permit a practicable channel of said depth to be obtained should be done, or caused to be done, by the city of Chicago without expense to the United States. The alteration of the tunnels was made the subject of special legislation in an act approved April 27, 1904. The tunnels have been lowered and the most obstructive bridges have been modified. The removal of the center-pier bridge at Lake Street during the year has been of very great benefit to navigation in the South Branch. The funds for lowering the tunnels was supplied by the traction company using them and those for removing or modifying obstructive bridges by the city of Chicago and owners of the bridges jointly. Cost of this tunnel and bridge work is not available.

Effect of improvement.—The size and capacity of steamers operating in the river have increased, and all vessels have been enabled to move with greater freedom and safety. On the other hand, due to urban requirements, there has been a continual introduction of new bridges and of more or less obstructive currents for sewage conveyance. The effect of these obstructions is cumulative, and commerce upon the river is decreasing. There has been no reduction in water or rail rates; the tendency has rather been to increase, but it is believed that the project has material effect in controlling freight rates.

Proposed operations.—It is proposed to apply the funds shown as available in the money statement for maintenance dredging and supervision. Probable date of exhaustion of funds, July 1, 1917.

The work proposed to be carried on with the funds to be furnished under the estimate submitted is, in order of relative importance, maintenance dredging and supervision.

Commercial statistics.—The commerce of this river has been reported under the head of Chicago Harbor, with the commerce of which it is naturally a part.

In addition to the lake commerce, now reported as 3,259,170 short tons, consisting principally of miscellaneous merchandise, coal, lumber, and grain, with a valuation of about \$241,530,509, there is a large

local commerce carried in the river by lighters, of which no official record is kept.

Amount expended on all projects from June 3, 1896, to June 30, 1916:

New work-----	\$1, 499, 873. 40
Maintenance -----	264, 884. 76
Total -----	<u>1, 764, 758. 16</u>
Balance available for fiscal year ending June 30, 1917-----	35, 368. 42
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	30, 000. 00

CALUMET RIVER, ILL. AND IND.

Location and description.—Calumet River lies in Cook County, Ill., and flows in a northerly direction into Lake Michigan near the boundary line between Indiana and Illinois. It is formed by the junction of the Little Calumet and Grand Calumet Rivers at a point about 7.12 miles south of the Elgin, Joliet & Eastern Railway bridge, which is near the old shore line of Lake Michigan, but the section that is under general improvement extends from the Elgin, Joliet & Eastern Railway bridge (dividing line between harbor and river) to and including Turning Basin No. 5 near “The Forks,” where there is an entrance to Lake Calumet, a distance of 5.47 miles. The Little Calumet rises in Laporte County, Ind., and flows in turn westerly, northwesterly, and easterly for about 60 miles, it being a very crooked stream; the Grand Calumet rises in Lake County, Ind., and flows westerly for about 18 miles.

Condition at the end of fiscal year.—Work done on this river has consisted mainly of dredging and the construction of turning basins, 21 feet depth being secured from the mouth of the river to the forks, and three turning basins 21 feet deep dredged, resulting in great advantage to navigation interests. The controlling depth is 21 feet in the main river for all months of the year; and the maximum draft that can be carried on June 30, 1916, is 20 feet from the mouth of the river to the forks, and 4 feet from the forks to Hammond, Ind. The river is farther navigable for 6-foot-draft boats to Riverdale on the Little Calumet, 12 miles from the river mouth. It can also be used by light-draft launches, such as can pass under bridges, nearly to Gary, on the Grand Calumet, about 20 miles from the river mouth, and to Blue Island, on the Little Calumet, about 14 miles from the river mouth, being stopped at that point by rapids. All original work of the existing project has been completed except the construction of two turning basins (Nos. 2 and 4), maintenance and supervision. The channel in the main river where 90 per cent of the river commerce is carried on is in good condition. Total expenditures under present project: For new work, \$743,300.71; for maintenance, \$115,195.63; total, \$858,496.34.

Local cooperation.—The act of July 5, 1884, provided as a condition precedent to expenditure by the United States that a right of way for the channel should be donated. As a result there has been conveyed to the United States about 23 acres of land bordering upon the Calumet River such as was necessary for its straightening and widening incident to the execution of the project. The value of this

land at the time of its conveyance was approximately \$23,000. The act of March 3, 1905, required as a condition precedent to Federal expenditure upon any one of the five turning basins the donation to the United States of the land necessary for that turning basin. As a result the land needed for turning basins Nos. 1, 3, and 5 has been conveyed to the United States. The total area thus conveyed is 17.85 acres, and the value of the land at the time of its conveyance was approximately \$35,700.

Effect of improvement.—The work has been beneficial, permitting the use of larger and deeper-draft vessels, carrying larger cargoes. There has been no known reduction in water or rail rates, but the existence of this improved river is considered to be of great use in controlling freight rates and is claimed to save at least 50 cents per ton over Chicago River rates and more over the usual Calumet (South Chicago) railroad rates.

Proposed operations.—It is proposed to apply the funds shown as available in the money statement to (a) dredging for maintenance and (b) supervision.

Probable date of exhaustion of funds, July 1, 1917.

All original work of the project has been completed except the construction of two turning basins (2 and 4), for which the land has not yet been donated, maintenance, and supervision, and no estimate for work toward completion of project is submitted.

The work proposed to be carried on with the funds to be furnished under the estimate submitted is the same, i. e., (a) dredging for maintenance and (b) supervision.

Commercial statistics.—The commercial statistics of this river have been reported under the head of Calumet Harbor, with the commerce of which it is naturally a part. Commerce for the calendar year 1915 was 6,968.660 short tons, the principal items being coal, iron ore, grain, and miscellaneous merchandise, the value of which is estimated at \$135,960,965.

Amount expended on all projects from July 5, 1884, to June 30, 1916:

New work	\$1, 144, 789. 21
Maintenance	160, 426. 11
Total	<u>1, 305, 215. 32</u>
Balance available for fiscal year ending June 30, 1917.....	27, 493. 01
Amount (estimated) required to be appropriated for completion of existing project.....	73, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	20, 000. 00

ILLINOIS RIVER, ILL.

Location and description.—The Illinois River, entirely within the State of Illinois, is formed by the confluence of the Kankakee and the Des Plaines Rivers at a point in Grundy County about 50 miles above La Salle, flows in a southwesterly direction, and empties into the Mississippi at Grafton, Ill., about 36 miles above St. Louis. The total length of the stream is 273 miles.

Existing project.—That portion of the river now under improvement by the United States from La Salle, the present head of navigation, to the mouth at Grafton is divided into two sections, viz, (a)

below Copperas Creek (general improvement), 137 miles, and (b) from Copperas Creek to La Salle, 86 miles.

(a) Below Copperas Creek (general improvement): The existing project for work below Copperas Creek, adopted in river and harbor act of June 14, 1880, contemplates improvement to a 7-foot depth at low water by dredging and by the construction of one lock each at Kampsville, $31\frac{1}{2}$ miles above the mouth of the river, and at La Grange, $77\frac{1}{2}$ miles above the mouth. Each lock is 350 feet long between sills and 75 feet wide, with 7 feet on the miter sills at low water of 1879. Estimated cost, \$1,692,837.81. There has been no modification of this project.

(b) Copperas Creek to La Salle: Since 1880 this section had not been a part of the general improvement prosecuted by the United States, but the river and harbor act of March 2, 1907, specifically appropriated \$50,000 for this section, to be applied to dredging and other improvement. The latest published map of this river, showing the works of previous and existing projects, appears opposite page 2942, Annual Report for 1914.

Condition at the end of fiscal year.—Work done on this river has consisted of lock-and-dam construction, dredging, and snagging. The results accomplished under all projects have been the construction of two locks and dams (completed, respectively, in 1889 and 1893 at a cost of \$920,134) and the deepening and maintenance of channel by dredging. The project as to new work is about 90 per cent completed. The increased depth and width benefit navigation and permit boats to operate throughout the year, except when the river is closed by ice. The controlling depth is 6 feet at low water as it prevails with the present unauthorized flow of water through the Chicago Drainage Canal. Work remaining to complete the project, i. e., to produce a channel 200 feet wide and 7 feet deep from Copperas Creek to the mouth, under the hypothesis that 4,166 second-feet will be introduced from Lake Michigan, is the dredging of about 1,500,000 cubic yards of material, of which about 700,000 cubic yards is original work and about 800,000 cubic yards is accumulated maintenance. The maximum draft that can be brought to the mouth of the river from the ocean is about 5 feet. Total expenditures under the existing adopted project have been: (a) Below Copperas Creek: For new work, \$1,571,856.23; for maintenance, \$165,204.43; total, \$1,737,060.66. (b) Copperas Creek to La Salle: For new work, \$33,341.18; for maintenance, \$12,697.08; total, \$46,038.26.

Local cooperation.—Owing to the failure of the General Government in 1869 to appropriate funds for the construction of a lock and dam on the Illinois River as a commencement of the recommended slack-water system, the General Assembly of the State of Illinois directed the construction of a lock and dam at Henry. Operations on this work were carried on under the direction of the State board of canal commissioners in substantial conformity with the plan of improvement recommended by the United States Board of Engineers in their report of December 17, 1867, and the work was completed at a cost to the State of approximately \$400,000. Likewise the State expended \$347,747 in completing the lock and dam at Copperas Creek in 1874 and 1877 after the United States had expended \$62,359 on foundation for the lock. It appears there were no "conditions imposed by law," as far as the wording of the river and harbor acts

were concerned, with reference to the above work. However, the Annual Report for 1873 (p. 437) states that the—

Improvement has thus far been carried on conjointly by the General Government and the State of Illinois, according to a system adopted some four years since—the State of Illinois undertaking the building of locks and dams and the United States preparing the river bed so as to afford, when the dams shall have been built, a navigation for vessels drawing 7 feet of water.

Effect of improvement.—Transportation by water has been made easier and a profitable and useful navigation is carried on the entire year, except when ice prevents. Up to as late as 1895 steamboats were compelled to suspend operations one or two months in the late summer and early fall nearly every year on account of low water. Since 1895 navigation has never been suspended for that reason. It is impossible to state with accuracy to what extent rates have been affected by river competition, but the existence of the river channel as an avenue of commerce results in lower rates upon a vastly greater tonnage than that actually transported on the river.

PROPOSED OPERATIONS BELOW COPPERAS CREEK.

It is proposed to apply the funds shown as available in the money statement as follows:

(a) Dredging—operation of dredge:		
Five months with single crew, at \$2,500_____	\$12,500.00	
Eight months with double crew, at \$4,500_____	36,000.00	
		\$48,500.00
(b) Surveys, snagging, general supervision_____		14,400.00
(c) Care and repair of property and plant:		
Completing barge No. 10 (hired labor)_____	3,628.58	
Maintenance of dredge, tender, etc_____	12,000.00	
Maintenance of 1 towboat_____	3,000.00	
Maintenance of auxiliary plant_____	5,993.90	
Building roadway to boatyard_____	900.00	
Dredging slip at Peoria_____	600.00	
		26,122.48
(d) Completing marine ways (hired labor)_____		16,949.34
Total_____		105,971.82

Probable date of exhaustion of funds, August 1, 1917.

An estimate of \$30,000 is submitted for the additional work proposed to be carried on up to June 30, 1918.

Commercial statistics.—The commerce throughout the entire portion of the river under improvement, as far as ascertainable, consisting chiefly of grain, live stock, coal, logs, apples, and general merchandise, amounted during the fiscal year to 239,677 short tons, valued at \$3,702,832. In addition, 74,172 passengers were carried.

Following is a statement of the commerce passing over the improved portion of Illinois River for the past three years:

Comparative statement.

Fiscal year.	Short tons.	Value.
1914.....	141,497	\$3,154,491
1915.....	178,199	3,730,458
1916.....	239,677	3,702,832

(A) BELOW COPPERAS CREEK (GENERAL IMPROVEMENT).

Amount expended on all projects from June 14, 1880, to June 30, 1916:

New work-----	\$2, 122, 668. 42
Maintenance -----	165, 204. 43
Total -----	<u>2, 287, 872. 85</u>

Balance available for fiscal year ending June 30, 1917-----	105, 971. 82
Amount (estimated) required to be appropriated for completion of existing project -----	44, 500. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement and for maintenance--	30, 000. 00

MISSISSIPPI RIVER COMMISSION.

Improvement of Mississippi River in charge of the Mississippi River Commission.

Commission headquarters.—St. Louis. Mo.

Commissioners.—The commissioners during the fiscal year were Col. C. McD. Townsend, Corps of Engineers, United States Army, president; J. A. Ockerson, civil engineer; Homer P. Ritter, assistant, United States Coast and Geodetic Survey; Col. J. G. Warren, Corps of Engineers, United States Army; Charles H. West, civil engineer; Col. Lansing H. Beach, Corps of Engineers, United States Army; and Edward A. Glenn.

Secretary and district officers.—The following officers of the Corps of Engineers, United States Army, were on duty under the commission during the year: Secretary, Maj. Clarke S. Smith; officer in charge of first and second districts, Maj. E. M. Markham; officer in charge of third district, Maj. John R. Slattery; officer in charge of fourth district, Maj. W. G. Caples.

Location and description.—The Mississippi River Commission, constituted by act of Congress of June 28, 1879, is in charge of the improvements of the Mississippi River from Head of Passes to the mouth of the Ohio River, including the rectification of Red and Atchafalaya Rivers at their junction with the Mississippi, the building of levees, and the improvement of the several harbors for which specific appropriations have been made. It is also charged with the survey of the Mississippi River from Head of Passes to its headwaters and with gauging the river and its tributaries. By act of Congress approved March 4, 1913, an appropriation for levees from Cape Girardeau, Mo., to Rock Island, Ill., was made for expenditure under the commission.

Present project.—The present project is to maintain a channel not less than 9 feet deep and not less than 250 feet wide from the mouth of the Ohio River to the Head of Passes near the Gulf of Mexico by open-channel work and by dredging; to confine the river to a permanent position as far as practicable by bank revetment and the construction of levees below Cape Girardeau, Mo., to regulate the river and to prevent overflow; and to build such levees between Rock Island, Ill., and Capt Girardeau, Mo., in aid of navigation as may be found necessary or desirable. In executing this work the commission is authorized to make such surveys, examinations, and investigations of the Mississippi River and its tributaries as may be

deemed necessary. (Acts of Congress approved June 28, 1879; June 3, 1896; Sept. 19, 1890; Mar. 3, 1905; June 4, 1906; and Mar. 4, 1913.)

Condition at the end of fiscal year.—The general survey of the Mississippi River from Head of Passes, La., to its headwaters at Lake Itasca, Minn., has been completed and maps of the river published. The resurvey from Cairo, Ill., to the mouth of Red River, La., has been completed and maps therefrom prepared for publication. Various discharge, gauge, and other observations have been made on the Mississippi River and tributaries and the Gulf of Mexico. Works for improvement of the channel have been executed at various places below Cairo. Revetment work below Cairo is now in place and in good condition on about 87 miles of river bank. There are 1,508 miles of effective levees, containing about 300,779,286 cubic yards, between Head of Passes, La., and Cape Girardeau, Mo., and about 452 miles of river front, protected by levees more or less effective, between Cape Girardeau, Mo., and Rock Island, Ill. The levees below Cape Girardeau protect about 26,569 square miles of land, and those above Cape Girardeau protect about 676 square miles. About 67 per cent of the total yardage required to complete the levees below Cape Girardeau is now in place. Dredging has been done annually since 1895 below Cairo where necessary to maintain a navigable channel 9 feet in depth. In the Mississippi River there is now, with rare exceptions, a good navigable channel at all stages, with a depth of 9 feet or more over a width of at least 250 feet, for a distance of 833 miles below Cairo, and a depth of not less than 30 feet over a width of several hundred feet for the remaining 240 miles to the Gulf of Mexico. The necessary plant required for surveys, dredging, and bank-protection work has been constructed and maintained.

Local cooperation.—It has been almost entirely in the construction of levees and revetments that the local authorities have contributed toward the improvement of the river. The organized levee boards have constructed a large portion of the existing levee line, but it is only in recent years that local interests have contributed toward revetment construction, and these contributions have been a small proportion of the cost of these works.

Effect of improvement.—In a general way it may be stated that the improvement is providing a safe and easy channel for navigation and is now in condition to prevent the destructive effects of floods in all except the most extreme high waters.

Proposed operations.—The maintenance of the project channel depths, the existing river location and present harbors, the prevention of caving banks, and the completion of the levee systems constitute the principal results for which funds are necessary.

Commercial statistics.—These are appended to the commission's report.

Estimate of funds required.—Amount that can be profitably expended in the fiscal year ending June 30, 1918, exclusive of the balance unexpended July 1, 1917:

For continuing the general improvement of the Mississippi River from the Head of Passes to the mouth of the Ohio River, for the building of levees from the Head of Passes to Rock Island, Ill., and for surveys, including salaries, clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission, \$6,000,000.

MISSISSIPPI RIVER BETWEEN THE OHIO AND MISSOURI RIVERS.

Location and description.—The Mississippi River rises in Lake Itasca, Minn., flows in a southerly direction about 2,500 miles, and empties into the Gulf of Mexico. The St. Louis engineer district embraces 200 miles, between the mouths of the Missouri and Ohio Rivers, the latter being about 1,075 miles from the Gulf.

Existing project.—The existing project, originally submitted by the district officer and approved by the Chief of Engineers March 31, 1881, was—

to make the improvement continuous, working downstream from St. Louis, by reclaiming land and building up new banks (using for the purpose permeable dikes or hurdles of piling to collect and hold the solid matter carried in suspension or rolled on the bottom by the river), thus reducing the width of the river to the uniform width of 2,500 feet. It is proposed by this means to secure a minimum depth of 8 feet. The depth is now liable to become as little as 4 feet in some places and less than 8 feet in every place where the width is greater than 2,500 feet. Caving banks are to be protected. (Annual Report for 1881, p. 1536.)

No estimate of cost was given except for certain localities. In 1883 the estimated total cost to complete the project was placed at \$13,327,500.

The project was modified by the river and harbor acts of 1896 and 1902, and practically abrogated by the acts of March 3, 1905, and March 2, 1907, and joint resolution of June 29, 1906. The river and harbor act of June 25, 1910, restored the plan adopted in 1881, together with dredging, with a view to obtaining and maintaining at standard low water (4 feet, St. Louis gauge) a minimum depth of 8 feet and minimum channel width of 200 feet from the mouth of the Ohio River to St. Louis (180 miles), and a minimum depth of 6 feet from St. Louis to the mouth of the Missouri River (16 miles), "with a view to the completion of said improvement within a period of 12 years," at an estimated cost of \$21,000,000, and \$400,000 annually thereafter for maintenance, in addition to all amounts already expended. (H. Doc. No. 50, 61st Cong., 1st sess., and H. Doc. No. 168, 58th Cong., 2d sess.)

Condition at the end of the fiscal year.—About 34 per cent of the project has been completed. The least draft over the shoalest locality between St. Louis and the mouth of the Ohio River has been increased about 4 feet, i e., from a minimum of 4 feet at the beginning of the improvement to 8 feet, the minimum draft at the end of the fiscal year and the project requirement at standard low water (4 feet, St. Louis gauge). The required depth, 8 feet, prevails without assistance by dredging or otherwise, for six months, or from March to August, inclusive, the corresponding gauge reading at St. Louis being 10 feet. Between St. Louis and the Missouri River the project depth of 6 feet has been maintained by bank revetment, with slight aid from dredging. The total expenditures under the existing project to June 30, 1916, were \$16,071,901.82, of which \$11,432,546.18 was for new work and \$4,639,355.64 was for maintenance.

There remains to be appropriated for completion of the existing project, \$16,700,000, to be expended in construction and maintenance of contraction works and bank protection at various localities, and in dredging.

Local cooperation.—The city of St. Louis has completed during the year a temporary municipal landing dock and warehouse, at a cost of \$20,000, and has plans under way for another similar dock and for a large permanent dock to cost \$250,000. This city and a number of smaller cities in the district have for many years maintained paved landings or wharves, the original cost of which was approximately \$500,000.

Effect of improvement.—The improvement has probably had a beneficial influence on freight rates, as the rates to localities reached by water are well known to be lower than those remote from this advantage, but an accurate estimate of such effect is impracticable. The effect of the improvement has been to render transportation easier and to facilitate commerce.

Proposed operations.—The balance of \$100,707.43 available July 1, 1916, and the amount of \$350,000 appropriated by the act of July 27, 1916, will be applied as follows:

Operations of four hydraulic pipe-line dredges.....	\$200, 000. 00
Maintenance of existing works.....	200, 707. 43
Office, engineering, surveys, gauges, and contingencies.....	50, 000. 00
Total	450, 707. 43

Under a reexamination of the project May 19, 1915, which was reviewed by the Board of Engineers for Rivers and Harbors November 9, 1915, the Chief of Engineers on November 23, 1915, instructed that the estimate for the year 1918 be limited to \$350,000.

The work proposed under this estimate is:

Operations of four hydraulic pipe-line dredges.....	\$200, 000
Maintenance of existing works.....	100, 000
Office, engineering, surveys, gauges, and contingencies.....	50, 000
Total	350, 000

Commercial statistics.—The river commerce at St. Louis, Mo., and within the district during the calendar year 1915, was composed of bauxite ore, cement, coal, cotton, cotton seed, garbage, grain and products, groceries, iron, live stock and products, logs, lumber, merchandise and sundries, and oil. The river commerce at St. Louis, Mo., and in the district during the last three calendar years was as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	258, 709	\$11, 755, 500
1914.....	204, 118	14, 922, 811
1915.....	258, 501	14, 013, 520

Amounts expended on all projects from Aug. 13, 1872, to June 30, 1916:

New work.....	\$12, 927, 546. 18
Maintenance.....	4, 639, 355. 64
Total.....	17, 566, 901. 82
Balance available for fiscal year ending June 30, 1917.....	450, 707. 43
Amount (estimated) required to be appropriated for completion of existing project.....	16, 700, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvements and for maintenance.....	350, 000. 00

MISSISSIPPI RIVER BETWEEN MISSOURI RIVER AND MINNEAPOLIS, MINN.

Location and description.—The Mississippi River rises in northern Minnesota and, running southerly, empties into Gulf of Mexico. The length of the section included in the project is 664 miles and the distance from its lower end to the mouth of river is about 1,275 miles.

Existing project.—The existing project for increasing the depth of the channel from $4\frac{1}{2}$ to 6 feet at low water by further contraction, to be accomplished by extending the dams already built the requisite length, thereby not abandoning any of the work already in place, was adopted by Congress in the river and harbor act of March 2, 1907, and is given in full with detailed estimate in House Document No. 341, Fifty-ninth Congress, second session. This project provides for obtaining a channel depth of 6 feet, with width varying from 300 feet at St. Paul to 1,400 feet between the Illinois and Missouri Rivers; the channel to be obtained by means of contraction works consisting of wing or spur dams for narrowing the main channel of the river and closing dams for closing side chutes, by rock excavation and by auxiliary dredging and repairs to work constructed under previous projects; the Rock Island Rapids to be surmounted by two locks, each having a length of 350 feet between miter sills, 80 feet clear width, and a depth of 6 feet on the miter sills at low water. The additional work contemplated at the Des Moines Rapids Canal, as also the improvement of the river from Montrose to Burlington, Iowa, about 31 miles, has been made unnecessary by the dam of the Mississippi River Power Co. at Keokuk, Iowa. The upper limit of the project named in House Document No. 341, Fifty-ninth Congress, second session, was the Omaha Bridge at St. Paul, but by the river and harbor act of March 2, 1907, which adopted the project, the upper limit was fixed at Minneapolis. Estimated cost of carrying out the project is \$20,000,000, with \$300,000 per annum for maintenance after completion. The river and harbor act of June 25, 1910, made an appropriation for this improvement "with a view to completing said improvements within a period of 12 years." The length of the section included in the project is 664 miles, and the distance from the lower end to mouth of river is about 1,275 miles.

Condition at the end of fiscal year.—At the end of the fiscal year the proportion of the approved project completed was about $39\frac{1}{3}$ per cent. The results in increased depth were satisfactory as heretofore, at least 2 feet additional being secured at localities where improvements were made during the year. Maximum draft that could be carried June 30, 1916, at extreme low water was 4 feet. The total expenditures, not including outstanding contracts or liabilities on the adopted project, were \$8,214,681.42, of which \$8,173,272.40 was for new work and \$41,409.02 for maintenance. There has been credited to the appropriation \$32,005.76, receipts from miscellaneous sources.

Local cooperation.—The Mississippi River Power Co. has contributed under the requirements of its franchise channel improvement by rock excavation at Keokuk, together with a lock, dry dock, lock grounds, buildings, and other appurtenances, at an aggregate cost of about \$1,162,324, as more fully enumerated on page 1021 of Annual Report for 1915.

Effect of improvement.—Transportation has been made easier and safer from year to year and the usual reduction in freight rates due to water competition is experienced, but comparatively little benefit

is expected until transfer and terminal facilities are provided at the various cities in which direction considerable progress has already been made. An increase in commercial water-borne freight of about 100,000 short tons is noted.

Proposed operations.—It is proposed to operate 6 hired labor plants in building dams and shore protections in the various river divisions, continuing the regularization. These 6 plants include 18 towboats and 218 barges, with the necessary quarter boats, building boats, fuel floats, launches, and motor skiffs. Contracts for similar work will be carried on in four divisions and for winter work in three divisions. Hired labor work in rock excavation will be performed on the Rock Island Rapids, and for miscellaneous work 4 dipper dredges, 8 dump scows, 2 drill boats and their accessories will be used. Progress will be made on the Le Claire Canal and in excavating a 6-foot channel with pipe-line and dipper dredges from the Omaha Bridge to Lock and Dam No. 1.

Estimate for fiscal year 1918, based on the proportional amount, \$2,000,000, required annually to complete the project by June 30, 1922.

1. For the operation for 6 to 7 months each of 6 hired labor plants belonging to the United States, consisting of 13 towboats, about 200 barges and their accessories in building and repairing dams and shore protections in 6 divisions of the district, aiming to place in the work about 1,000,000 cubic yards of riprap rock and brush in varying proportions-----	\$1, 000, 000
2. For work under contract in 5 divisions building and repairing dams and shore protections, aiming to place in the work about 400,000 cubic yards of rock and brush in varying proportions--	400, 000
3. For work in the 3 northern divisions in building and repairing dams and shore protections on the ice, with the intention of placing in the work about 85,000 cubic yards of riprap rock and brush -----	75, 000
4. For the operation of 8 United States pipe-line dredges at various localities throughout the district in removing sand from channel, in dredging temporary channels, and building foundations of dams, and with the intention of moving about 1,700,000 cubic yards of sand for these purposes, 6 months each; 48 months, at \$2,500 per month-----	120, 000
5. For operating 2 drill boats and 2 dipper dredges to remove about 10,000 solid cubic yards of rock from the Rock Island Rapids--	50, 000
6. For continuing construction of Le Claire Canal as far as the funds will permit, providing machinery, tools, and other appliances, building cofferdams, and excavating rock-----	250, 000
7. Surveys and gauges-----	15, 000
8. Purchase, construction, care, and repair of plant-----	90, 000
Total -----	2, 000, 000

Commercial statistics.—The commerce, aside from Government material consisting of rock and brush used in construction work, was of a miscellaneous character, the largest items being sand and gravel.

Comparative statement.

Calendar year.	Total.	Commer- cial.	United States material.	Value.
	<i>Short tons.</i>	<i>Short tons.</i>	<i>Short tons.</i>	
1913.....	2, 145, 315	1, 372, 923	772, 292	\$32, 705, 137
1914.....	1, 426, 970	1, 145, 785	281, 185	41, 324, 041
1915.....	1, 883, 668	1, 255, 593	450, 183	52, 785, 118

There is an increase from 1914 of 115,407 short tons in miscellaneous freight; the ton-miles increased 11,489,183, and the valuation \$11,461,077.

Amount expended on all projects from June 18, 1878, to June 30, 1916:

New work -----	\$27, 240, 358. 02
Maintenance -----	79, 409. 02
Total -----	<u>27, 319, 767. 04</u>
Balance available for fiscal year ending June 30, 1917-----	1, 589, 832. 58
Amount (estimated) required to be appropriated for completion of existing project-----	10, 125, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement and for maintenance--	2, 000, 000. 00

MISSISSIPPI RIVER BETWEEN BRAINERD AND GRAND RAPIDS, MINN.

Location and description.—For general description of the Mississippi River, see “Mississippi River between St. Paul and Minneapolis.” The section of the Mississippi River included in this improvement flows in a southwesterly direction from Grand Rapids to Brainerd, Minn., a distance of about 180 miles. Brainerd, at the lower end of this section, is about 170 miles above St. Paul, Minn. At each end of the section under improvement is a power dam without a lock.

Existing project.—The river and harbor act approved June 25, 1910, adopted a project for completing this improvement at an estimated cost of \$22,555. This project aims at securing a practicable channel not less than 60 feet wide and 3.5 feet deep at mean low water between Brainerd and Grand Rapids by means of dredging, wing dams, cut-offs, and the removal of snags and overhanging trees, in accordance with plan printed in House Document No. 607, Sixty-first Congress, second session (no maps). In 1913 the estimate was increased to \$30,555 on account of the increased cost of the plant over that originally estimated, and also because the nature of the material dredged was such as to cost more than had been expected. The estimate for maintenance is \$2,000 annually.

Condition at end of the fiscal year.—The project depth of 3.5 feet at mean low water which corresponds to 3 feet and 2.5 feet on the Aitkin and Sandy Lake gauges, respectively, has been attained. About 85 miles of river has been cleared of overhanging trees and 93 miles of channel cleared of snags. The improvement has resulted in an increased available depth during mean low water of 2 feet; has increased the available width of the channel, and has made navigation less hazardous. The total expenditures under the existing project were \$29,088.63 for new work and \$2,059.90 for maintenance, a total of \$31,148.53.

Effect of improvement.—The work of improvement has given a safer channel and has doubtless kept down freight rates on the river. There is no railroad competition.

Proposed operations.—The funds on hand will be used in snagging and removing overhanging trees, etc., using Government plant and hired labor, and will be expended prior to July 1, 1917.

Operation of U. S. dredge <i>Oriole</i>	\$2, 500. 00
Removal of overhanging trees, etc.....	500. 00
Administration and contingencies.....	447. 48
Total	3, 447. 48

The funds estimated for the fiscal year 1918 are to be expended in removing snags and overhanging trees, using Government plant.

Operation of the dredge <i>Oriole</i>	\$1, 400
Purchase of supplies, repairs, etc.....	400
Administration and contingencies.....	200
Total	2, 000

Commercial statistics.—The commerce consists mainly of floating loose pine logs and rafts of cedar posts and poles, ties and pulpwood, which is carried on over the entire section. One steamboat makes weekly trips over part of this stretch giving a scheduled passenger and freight service to the settlers.

Comparative statement.

Calendar year.	Short tons.	Value.	Passengers carried.	Receipts, passenger carriers.	Steam-boats.	Launches, commercial, pleasure.
1913.....	466, 275	\$2, 114, 000	700	\$900	1	10
1914.....	424, 600	1, 903, 500	800	950	1	20
1915.....	366, 700	1, 473, 000	1, 000	1, 000	1	20

No change in nature of commerce has resulted from improvement, nor have any boat lines been established or abandoned.

Amount expended on all projects from July 11, 1870, to June 30, 1916:

New work.....	\$48, 089. 59
Maintenance	2, 059. 90
Total	50, 149. 49

Balance available for fiscal year ending June 30, 1917.....	3, 447. 48
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	2, 000. 00

MISSISSIPPI AND LEECH RIVERS, MINN.

Location and description.—For general description of the Mississippi River see “Mississippi River between St. Paul and Minneapolis.” The section of the Mississippi River included in this improvement flows in a southeasterly direction from Winnibigoshish Dam to Pokegama Dam, a distance of about 65 miles.

Leech River has its source at the outlet of Leech Lake and flows in an easterly direction about 29 miles to the Mississippi River, which it enters about 40 miles above Pokegama Dam, the latter being 350 miles above St. Paul, Minn. The portion of Leech River included in the improvement is that between Leech Lake Dam and the Mississippi River, a distance of 27 miles.

Existing project.—The project was adopted by the river and harbor act of March 4, 1913 (H. Doc. No. 1223, 62d Cong., 3d sess., with maps), and provides for straightening the channel by means of dredged cut-offs and the partial closing of auxiliary channels by

suitable dams, at an estimated cost of \$296,000 for improvement and \$15,000 annually for maintenance. The lengths of the sections under improvement are: Mississippi River, 65 miles; Leech River, 27 miles. The downstream end of the improvement is at Pokegama Dam, about 2,280 miles above the mouth of the Mississippi River. The minimum channel width provided for Leech River is 100 feet; for the Mississippi River above the mouth of Leech River, 100 feet; and for the Mississippi River below Leech River, 125 feet; all with a depth of 8 feet at a bank-full stage, which is about 10 feet on the Pokegama Reservoir gauge.

Condition at the end of fiscal year.—The work has been the building of the dredge fleet and dredging 143,780 cubic yards. About 19 miles of river has been worked over and the channel straightened. This was accomplished by making six cuts, shortening the channel by 2.5 miles. There still remains 73 miles of river to be worked over, requiring the dredging of about 1,856,000 cubic yards and the construction of suitable dams in old channels. The maximum draft that can be carried over the shoalest part of the sections under improvement (9 miles below Winnibigoshish Dam) varies from zero to 4 feet, being dependent upon reservoir discharges, a ruling depth of at least 2 feet being available throughout the navigation season (May 1–Nov. 1). The total expenditures to June 30, 1916, were \$88,622.71 for new work.

Effect of improvement.—None; the project not being sufficiently advanced.

Proposed operations.—The funds on hand will be expended in dredging between Cohasset and the mouth of Leech River with Government plant and hired labor.

Operation of U. S. dredge <i>Manito</i> and fleet	\$75, 000. 00
Administration and contingencies	7, 580. 66

Total	82, 580. 66
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The foregoing funds will probably be exhausted by July 1, 1917. The funds estimated for fiscal year 1918 will be expended in continuing the dredging as above.

Operation of U. S. dredge <i>Manito</i> and fleet	\$31, 000
Fuel and supplies	8, 000
Surveys	3, 000
Administration and contingencies	8, 000

Total	50, 000
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Commercial statistics.—The commerce on the rivers in this improvement is mainly that of floating logs and rafts of cedar posts and poles, ties, and pulp wood. There are several steamboats and gasoline launches engaged in connection with this business; also a large number of launches operated for pleasure only.

Comparative statement.

Calendar year.	Short tons.	Value.	Passengers carried.	Receipts, passenger carriers.	Steam-boats.	Launches, commercial, pleasure.
1913.....	240,000	\$935,628	.....	.....	2	45
1914.....	386,225	1,486,800	.....	.....	2	50
1915.....	238,000	916,000	6,730	\$4,218	3	60

Amount expended on all projects from Mar. 4, 1913, to June 30, 1916: New work-----	\$88,622.71
Balance available for fiscal year ending June 30, 1917-----	82,580.66
Amount (estimated) required to be appropriated for completion of existing project-----	120,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement-----	50,000.00

OSAGE RIVER, MO.

Location and description.—The Osage River rises in the southwestern part of Kansas and flows in a general easterly course to the middle of the State of Missouri, thence in a northeasterly course, its total length being 500 miles, and empties into the Missouri River about 142 miles above its mouth and 8 miles below Jefferson City, Mo.

Existing projects.—The first appropriation was made by the river and harbor act of March 3, 1871. It is believed to have been based on an examination report printed in House Document No. 60, Forty-first Congress, third session (Annual Report for 1871, p. 327), although this report was not adopted specifically by Congress as a project. It contemplated deepening the channel over shoals by dredging up to Roscoe, 283 miles above the mouth, at an estimated cost of \$200,000. Under the first and subsequent appropriations regulation work, consisting of repairs and construction of training walls and wing dams, snagging, and dredging, has been carried on with the object of securing a channel 80 feet wide, with a depth of 3 feet at mean low water. The project was modified by the river and harbor act of September 19, 1890, which authorized the commencement of construction of a lock and dam near the mouth of the river, and by the river and harbor act of March 3, 1899, which adopted the project for a lock and dam printed in Annual Report of Chief of Engineers for 1898, page 3470.

By act of June 24, 1902, Congress declared the river not navigable above the dividing line between Benton and St. Clair Counties, Mo., and by act of March 4, 1904, not navigable above the vicinity of Warsaw, Mo., the act of January 14, 1901, having authorized construction of a dam across the river at Warsaw, 172 miles above the mouth.

The lock and dam is 7 miles above the mouth of the river and the nearest town is Osage City, Mo., near the mouth. The lock is 220 feet long, with a clear width of 42 feet; lift, 16 feet; available depth on miter sill at low water, 9 feet. The lower part of dam is of concrete, 9 feet high, on top of which is a movable dam, consisting of 5 Chittenden Weirs, each 75 feet long, and 415 feet of chanoine wickets; height of movable dam, 7 feet; total length of dam, 840 feet. Five piers, each 10 feet wide, separate the weirs from each other and from the chanoine wickets. The bed of the river consisted of gravel, and the foundation of dam was built of timber-capped piles to about 3 feet below river bed. This was partly undermined and 6 feet of reinforced concrete was subsequently placed in the foundation under the dam. Estimated cost of lock and dam, \$325,000. In recent years regulation work has been confined to the section below Linn Creek, near the mouth of Niangua River, 109 miles above the mouth of the Osage. The channel width of the regulated shoals is about 80 feet, with a 3-foot depth at mean low water. For latest published map see page 2012 of Annual Report for 1911.

Condition at the end of fiscal year.—Records of the work by the State of Missouri prior to 1870 are very meager, but remains of wing dams and training walls aggregating 10,000 linear feet are still traceable, though much damaged by floods. The open-channel improvement by the Government is one which necessitates maintenance and renewal from year to year, hence the work must be considered indefinite. This work began in 1873 and to June 30, 1916, was as follows:

Wing dams and training walls built.....	linear feet__	60,761
Wing dams and training walls repaired.....	do.....	14,519
Gravel dredged from channel through shoals.....	cubic yards__	146,841
Snags and obstructions removed from channel.....		15,261

The result of the expenditures has been to increase the depth over the shoals, remove obstructions, and maintain navigation. In the improved sections the channel is becoming fixed, the least depth at low water over the shoals that are dredged is from 2 to 3 feet and light-draft traffic has been made possible from Bagnell to the mouth, 70 miles, throughout the year. Improvement work is now in progress from Bagnell to Linn Creek, 38.4 miles, and, except at extreme low water during September and October, light-draft traffic is maintained. The total expenditures to June 30, 1916, amounted to \$1,048,165.80, of which \$639,521.86 was for new work (including \$375,637.52 for lock and dam) and \$408,643.94 was for maintenance subsequent to July 1, 1903 (including \$260,171.72 for maintenance and repairs of lock and dam). Prior to that time the amounts expended for works of improvement and for maintenance were so involved that it is impracticable to separate them. The lock was placed in operation in March, 1906, and the dam in February, 1911, but the dam was not entirely completed until January 12, 1914. The actual cost of the lock and dam was \$635,809.24.

Local cooperation.—The project was adopted without the imposition of special conditions for local cooperation.

Effect of improvement.—The completion of the lock and dam has resulted in submerging 10 of the shoals next above the lock. Continuous open-channel work has been completed to Bagnell, Mo., a distance of 70 miles above the mouth, which has made this section of the river capable of uninterrupted navigation for light-draft traffic during the low-water periods. There are practically no rail facilities, but the improvement has afforded shippers regular means of transportation by boat.

Proposed operations.—With the funds available July 1, 1916, it is proposed to carry on the work as follows:

New wing dams and training walls.....	\$3,700.00
Operation and repair of dredge No. 1.....	4,000.00
Maintenance of existing works.....	500.00
Construction of fish ladder at Lock and Dam No. 1.....	550.00
Superintendence and office expenses.....	548.04
Total	9,298.04

All work is done by hired labor and Government plant, the rate of expenditure being about \$1,300 per month, which will exhaust the available funds about January 10, 1917.

The river and harbor act of July 27, 1916, contains an appropriation of \$15,000 for this improvement and for maintenance. It is proposed to expend the funds as follows:

New wing dams and training walls.....	\$4, 000
Operation and repair of dredge <i>No. 1</i>	5, 000
Maintenance of existing works.....	5, 000
Superintendence and office expenses.....	1, 000
Total	15, 000

The Government plant to be operated on the river, the expenditures for which are included in the above figures, consists of 1 tow-boat, 1 dredge, 1 quarter boat, 1 material barge, and necessary small pieces. It is proposed to carry on work with the funds estimated as necessary for the fiscal year ending June 30, 1918, as follows:

New wing dams and training walls.....	\$4, 000
Operation and repair of dredge <i>No. 1</i>	5, 000
Maintenance of existing works.....	5, 000
Superintendence and office expenses.....	1, 000
Total	15, 000

Commercial statistics.—The commerce reported for the calendar year 1915 shows that 22,083 tons consisted of miscellaneous merchandise, grain, and feed, of which 95 per cent was transported over the completed improved section. The following table gives a comparative statement of commerce for the calendar years indicated:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	22,563	\$262,000
1914.....	31,308	415,715
1915.....	22,083	330,999

The general character of the commerce for the current year 1915 consisted principally of miscellaneous merchandise, grain, feed, live stock, railroad ties, and cordwood amounting to 22,083 tons, valued at \$330,999.

Amount expended on all projects from Mar. 3, 1871, to June 30, 1916:

New work.....	\$639, 521. 86
Maintenance	408, 643. 94
Total.....	1, 048, 165. 80
Balance available for fiscal year ending June 30, 1917.....	24, 298. 04
Amount (estimated) required to be appropriated for completion of existing project	Indefinite.

Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement.....	10, 000. 00
For maintenance of improvement.....	5, 000. 00
Total.....	15, 000. 00

GASCONADE RIVER, MO.

Location and description.—The Gasconade River rises in the southern part of Missouri and flows in a general northeasterly course for a distance of about 200 miles, entering the Missouri River at Gasconade, Mo., 110 miles above its mouth.

Existing project.—No definite project based on an examination report has been adopted by Congress. The first appropriation was made by the river and harbor act of June 14, 1880, for removing snags, and the next and subsequent appropriations specified continuing the improvement. A report on a survey of the river, printed in Senate Document No. 99, Forty-sixth Congress, second session, contains a plan for partial improvement at an estimated cost of \$50,000. It provided for deepening and straightening the low-water channel over the worst shoals by means of low, cheaply constructed dikes and for removing snags. In recent years work has been confined to the section below Cooper Hill, 39.5 miles above the mouth, the channel width of the regulated shoals being about 80 feet, with a depth of 2 feet at mean low water. The river and harbor act approved July 27, 1916, provided for the removal of the dam near Heckman's mill at Pryors Bend, or any other obstruction to the flow of water at or near that point, in the discretion of the Secretary of War. For latest published map, see House Document No. 190, Sixty-third Congress, first session.

Condition at the end of fiscal year.—The improvement of this river by open-channel methods has been prosecuted at some of the worst shoals, but no consolidated tabulation of the work accomplished can be made, as the earlier records do not state the amount of work done. The result of the expenditure has been to increase the depth over the shoals, remove obstructions, and maintain navigation. In the improved localities the channel is becoming fixed, the least depth at low water over the shoals being $1\frac{1}{2}$ to 2 feet. The total expenditures to the end of the fiscal year amounted to \$201,076.14, of which amount \$134,008.30 was for new work and \$67,067.84 was for maintenance subsequent to July 1, 1903. Prior to that time the amounts expended for works of improvement and for maintenance were so involved that it is impracticable to separate them.

Effect of improvement.—There are practically no rail facilities. The improvement has afforded shippers a regular means of transportation by boat.

Proposed operations.—With the funds available July 1, 1916, it is proposed to carry on the work as follows:

New wing dams and training walls	\$4, 900. 00
Operation and repair of power boat No. 1	600. 00
Maintenance of existing works	3, 500. 00
Superintendence and office expenses	497. 25
Total	9, 497. 25

All work is done by hired labor and Government plant, the rate of expenditure being about \$1,500 per month, which will exhaust the available funds about December 31, 1916.

The river and harbor act approved July 27, 1916, contains an item of \$10,000 for this improvement and for maintenance. It is proposed to expend these funds as follows:

New wing dams and training walls-----	\$5, 500
Operation and repair of power boat <i>No. 1</i> -----	1, 500
Maintenance of existing works-----	2, 500
Superintendence and office expenses-----	500
Total -----	10, 000

The Government plant to be operated on the river, the expenditures for which are included in the above figures, consists of 1 gasoline towboat, 1 power boat (combined derrick and pile driver), 1 quarter boat, 1 material barge, 1 towing barge, and necessary small pieces.

It is proposed to carry on work with the funds estimated as necessary for the fiscal year ending June 30, 1918, as follows:

New wing dams and training walls-----	\$10, 000
Operation and repair of power boat <i>No. 1</i> -----	1, 500
Maintenance of existing works-----	3, 000
Superintendence and office expenses-----	500
Total -----	15, 000

Commercial statistics.—The commerce reported for the calendar year 1915 shows that 22,037 tons consisted of miscellaneous merchandise, grain, feed, and flour, all transported over the improved section. The following table gives a comparative statement of commerce for the calendar years indicated:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	28, 696	\$308, 000
1914.....	43, 053	449, 573
1915.....	22, 037	340, 876

The general character of the commerce for the calendar year 1915 consisted principally of miscellaneous merchandise, grain, feed, flour, live stock, railroad ties, and sand and gravel, amounting to 22,037 tons, valued at \$340,876.

Amount expended on all projects from June 14, 1880, to June 30, 1916:

New York-----	\$134, 008. 30
Maintenance -----	67, 067. 84
Total -----	201, 076. 14

Balance available for fiscal year ending June 30, 1917-----	19, 497. 25
Amount (estimated) required to be appropriated for completion of existing project-----	Indefinite.

Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement-----	10, 500. 00
For maintenance of improvement-----	4, 500. 00
Total -----	15, 000. 00

KANSAS RIVER, KANS.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 584, Sixty-third Congress, second session:

The Kansas River, more commonly called the Kaw, is formed by the junction of the Republican and Smoky Rivers, flows easterly 176 miles, and empties

into the Missouri River at Kansas City. Following the great flood of 1903, the State of Kansas created the Kaw Valley drainage district, under the control of the Kaw Valley Drainage Board, for the purpose of placing the river in condition to avoid the disastrous effects of another similar flood. In the river and harbor act approved July 25, 1912, Congress adopted a project for improvement of this river by the United States from the mouth up to Argentine, Kans., which provides for Federal supervision as to harbor line encroachments, bridge reconstruction, and removal of débris and obstructions from the bed of the river. The further work now proposed consists in a more active participation by the United States in the work of improvement so far as warranted in the interests of commerce and navigation. The district officer is of opinion that the present and prospective commerce of the river is sufficient to warrant the expenditure by the United States of \$10,000 in the construction of two dikes at the mouth of the river and the removal of solid obstructions from the river to 15 feet below low water, in accordance with the following estimate:

Removal of wreckage-----	\$68, 000
Dikes at mouth-----	12, 000
Total-----	80, 000

It is proposed that railroads and other parties should pay \$60,000, the Kaw Valley Drainage Board \$10,000, and the United States \$10,000. There is now on hand the sum of \$4,000, appropriated for execution of the present project, which should be made available for the work now proposed. The division engineer concurs in believing that the river is worthy of improvement to the extent indicated.

I concur with the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Kansas River from the mouth to the western limits of Kansas City, Kans., is deemed advisable to the extent of constructing two dikes at the mouth and removing solid obstructions from the river to a depth of 15 feet below mean low water, at an estimated cost of \$80,000, of which \$10,000 should be borne by the General Government and the remainder by local interests.

MISSOURI RIVER.

Location and description.—The Missouri River is formed by the junction of the Jefferson, Madison, and Gallatin Rivers at Three Forks in southwestern Montana, flows north to above the central line of the State, thence northeast into western North Dakota, thence in a general southeasterly course through North and South Dakota, thence southeast, separating Iowa and Missouri from Nebraska and Kansas, entering the State of Missouri at Kansas City, thence in a general easterly course across Missouri, entering the Mississippi River about 18 miles above St. Louis, 2,551 miles from Three Forks.

The method of making appropriations for the improvement of the Missouri River makes it desirable to report separately for each section as follows: (1) Kansas City to the mouth, 392 miles; (2) Kansas City to Sioux City, Iowa, 415 miles; (3) Sioux City, Iowa, to Fort Benton, Mont., 1,478 miles.

MISSOURI RIVER, KANSAS CITY TO THE MOUTH.

Location and description.—See page 1131.

Original condition.—The original condition of this section of the river was one of alternate pools and bars, obstructed by numerous snags. The minimum available low-water depth was about 3 feet.

Existing project.—The existing project for this 392-mile section of the river was adopted by the river and harbor act of July 25, 1912. It provides for securing a permanent 6-foot channel, with a normal

low-water width of 1,200 feet, at an estimated cost of \$20,000,000, the work to be completed within a period of 10 years. The estimated cost of maintenance is \$500,000 per year. (See H. Doc. No. 1287, 61st Cong., 3d sess.) The work proposed is the protection of the banks by revetments, the contraction of channel by dikes, and the removal of snags. For latest published map see page 2795 of Annual Report for 1915.

Condition at the end of fiscal year.—Prior to the adoption of the existing project much of the work was of an experimental nature, constructed in isolated localities, and was practically obliterated without accomplishing the desired results. Under the previous project for the systematic improvement of the "first reach," a 45-mile section from Murrays Bend, near Jefferson City, Mo., to Gasconade River, there was constructed 12.3 miles of revetment, 104,040 linear feet of dike, 2,800 linear feet of abattis, and 1 bank head. The construction of this work extended from 1892 to 1901 and produced a low-water depth of at least 6 feet where naturally as little as 2½ feet had existed. The cost was about \$2,500,000.

Under the existing project, beginning with the appropriation of June 25, 1910, for systematic work on the 6-foot channel, the work is about 17 per cent completed. The work accomplished includes 50.79 miles of revetment for the purpose of permanently fixing the banks, 46,365 linear feet of dikes, and 1,705 feet of abattis for rectification of channel widths and closing auxiliary chutes. In the improved localities, which aggregate about 65 miles in length, the channel is becoming fixed, and there is a marked improvement of channel depths. For the purpose of hastening the progress of improvement in the most unstable sections of the river, and because of the accessibility of willow brush, an important article in the construction of the works, starting points for improvement were selected as follows: Kansas City, mile 392; Waverly, mile 299; Nigger Bend, mile 223; improved first reach, upper end above Jefferson City, mile 155, lower end at Gasconade River, mile 110; and St. Charles, mile 28.

Kansas City was selected because it was the head of the improvement contemplated, and because the river was held to some extent for a distance of 11 miles above and 6 miles below by corporations and private interests.

Waverly was selected because of bluff contact, and because the river for a distance of 37 miles above had but little tendency to wander from bluff contact.

Nigger Bend was selected in 1913, because improvement work had previously been done at this location, and because with improvement in the bends immediately above and below, it would soon permit of a completed section from Glasgow above, to, and below Boonville; also it was expected with continued regular appropriations to make early junction with the improvement carried upstream from Jefferson City at the upper end of the first reach.

The first reach was selected because of the improvement completed by the Missouri River Commission, and because it enabled work to be done from both ends—that is, up and down stream.

St. Charles was selected because private interests had held and would continue to hold the river under the bridges, and because it

permitted the earliest extension of the improvement to the mouth of the river.

Good progress has been made on two of the above subdivisions. On the first, all but three bends have been revetted between Kansas City and Sibley, 42 miles. Over this distance the required depth was obtained, except in one crossing, where the depth was 5 feet at mean low water. From Sibley to Waverly the river conditions have been disturbed by a cut-off, which occurred July 3, 1915, across the neck of Napoleon Bend, and improvement will therefore be delayed until settled conditions obtain. The river is practically in its original condition, with a depth of $3\frac{1}{2}$ feet at mean low water, between Sibley and Waverly.

The stretch from Waverly to Glasgow, a distance of 61.5 miles, is the most unstable section of the river, but only four crossings had as little as 4 feet depth. From Glasgow to Nigger Bend, a distance of 16.5 miles, improvement work has been completed in two bends and is under construction and projected for the remainder. Over this stretch of the river the required depth prevails.

From Nigger Bend to Lupus, a distance of 39 miles, only one crossing was found with a least depth of $3\frac{1}{2}$ feet. From Lupus to Washington, a distance of 111 miles, is the second stretch on which good progress has been made with the systematic improvement, by extending the work both up and down stream from the improved "first reach," formerly 45 miles in length. Over this stretch of the river two crossings were found where the depths were only $3\frac{1}{2}$ feet, but they were at localities where the river needs rectification to the proposed width. From Washington to St. Charles, a distance of 43 miles, the river is practically in its original condition, where a depth of $3\frac{1}{2}$ feet was found on three crossings. From St. Charles to the mouth, a distance of 28 miles, the upper 12 miles has been protected by revetment, constructed by private interests and the United States, along which the proposed depth is found, but over the remaining stretch of unimproved river one crossing has $3\frac{1}{2}$ feet depth.

To summarize, the maximum draft over the shoalest part of the improved localities was $4\frac{1}{2}$ feet and over those unimproved $3\frac{1}{2}$ feet at mean low water, these depths occurring during a month and a half preceding the close of the navigation season, November 30. During the remainder of the season the ruling depth fluctuated, being sometimes as much as 9 feet at times of high water, but there was not a dependable depth in excess of $4\frac{1}{2}$ to 5 feet over this entire section of river for any considerable length of time.

The work remaining to be done is the construction of the necessary dikes to hold the channel along about 50 miles of bluff contact, and of the necessary dikes and revetment for about 200 miles of river. The total expenditures under the existing project up to the end of the fiscal year, beginning with the appropriation of June 25, 1910, for systematic work on the 6-foot channel, amount to \$4,869,546.03, divided as follows:

New work	\$4, 274, 114. 70
Maintenance	595. 431. 33

Local cooperation.—The project was adopted without any conditions for local cooperation. A municipal wharf was completed in 1911 at Kansas City, Mo., at a cost of about \$70,000, which was paid

by the city. Upon request by the interests concerned authority has been granted for local cooperation as follows:

Mouth of Kansas River, right bank, mile 392.—Cooperation with Kaw Valley Drainage Board in the construction of a longitudinal dike along the harbor line approved June 20, 1912. Modification was authorized by the Chief of Engineers October 19, 1914, the total cost to the Government not to exceed \$10,000. The work was completed December 3, 1915, at a total cost of \$28,022.15, of which the Government paid \$10,000.

East Bottom Bend, right bank, mile 388.—Cooperation with Kansas City, Mo., in the construction of a longitudinal dike along the harbor line and cross dikes, approved September 18, 1911. The estimated cost to the Government was \$105,000. Plans and specifications were approved July 20, 1912, and the city authorities notified that the United States was ready to begin construction. No work has been done, and the mayor on June 14, 1916, states: "The city has abandoned the original plan * * * and we do not feel like standing any part of the expense of putting in the dike on the harbor line." As navigation would not be benefited as much as local interests, no work will be done by the United States at present.

The following work has been done during the year without cooperation on the part of the United States:

The Wabash Railroad Co. has expended approximately \$——, as repairs to existing works where the tracks pass along the river banks between miles 365 and 266. At mile 275 on left bank they constructed 2,200 linear feet of standard revetment and 1,500 linear feet of wire mattress revetment at an approximate cost of \$40,000.

The Missouri Pacific Railway Co. expended approximately \$126,900 as repairs to existing works between miles 325 and 173. At mile 342, right bank, 1,200 linear feet of standard revetment, at an estimated cost of \$12,000; at mile 328, right bank, 3,706 linear feet emergency wire mattress at an estimated cost of \$27,000.

The citizens of New Haven, Mo., right bank, mile 87, extended standard revetment 1,683 linear feet, at an estimated cost of \$5,788.

The Chicago, Burlington & Quincy Railroad Co., left bank, mile 9, repaired existing work and extended standard revetment 500 linear feet at an estimated cost of \$25,119.05.

Effect of improvement.—The effect of improvement has been to make navigation easier and safer and to give lower freight rates, the actual water rates being about 80 per cent of the railroad rates. A navigation company was organized in 1910 and now has two towboats and a number of large steel compartment barges in regular operation, with wharfage and terminal facilities at Kansas City, Mo., and East St. Louis.

Proposed operations.—With funds available July 1, 1916, it is proposed to carry on the work as follows:

By contract:		
424,000 feet standard revetment	\$381, 808. 50	
17,700 feet standard dikes	253, 603. 50	
		\$635, 412. 00
By hired labor and Government plant:		
31,000 feet standard revetment	164, 397. 64	
17,000 feet standard dike	255, 000. 00	
Construction of steel-hull towboat	19, 603. 00	
Maintenance and repair at boat yard	30, 000. 00	
Operations of repair party in making necessary repairs to revetments and dikes that have suffered deterioration or injury	22, 000. 00	
Operations of snag boat <i>Missouri</i> , including repairs	16, 500. 00	
Surveys, superintendence, and office expenses	30, 000. 00	
		537, 500. 64
Total		1, 172, 912. 64

The rate of construction for each construction force per month is about 1,500 linear feet of standard revetment and 1,000 linear feet of dike, at a cost of \$158,000. At this rate it is expected the funds will be exhausted about January 31, 1917. The operations of the snag boat cost about \$3,000 per month, and it is expected to keep her in commission to December 15, 1916. The operations of the repair party cost about \$4,000 per month, and it is expected to suspend work about December 15, 1916. Surveys, superintendence, and office expenses average about \$2,500 per month.

The river and harbor act of July 27, 1916, provided \$1,500,000 for this improvement and for maintenance, which it is proposed to expend as follows:

Systematic works of improvement:

Standard revetment-----	\$690, 000
Standard dike-----	600, 000

Maintenance and repair:

Necessary repairs to revetments and dikes that have suffered deterioration or injury-----	100, 000
Operations of snag boat <i>Missouri</i> , including repairs-----	30, 000
Ordinary repairs to floating plant, consisting of 5 towboats, 6 pile drivers, 8 quarter boats, 7 mattress barges, 7 gasoline launches, 40 material barges, and minor pieces-----	30, 000
Surveys, superintendence, and office expenses-----	50, 000

Total-----	1, 500, 000
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The Government plant to be operated on the river, the expenditures for which are included in the above figures, consists of one snag boat, six working plants for handling revetment and dike construction, and one repair plant. Each construction plant consists of a towboat, a quarter boat, a combined grader and pile driver, a mattress barge, and seven material barges, with other small accessories, and requires about \$100,000 per year for its operation, including the cost of materials and for the work it does. The repair plant consists of a towboat, a quarter boat, a combined grader and pile driver, and three material barges, with necessary small pieces, and requires about \$50,000 per year for its operation, including materials for the repair work. In addition to the work done by the regular repair party, it is estimated that the construction forces will expend about \$50,000 in emergency repairs to works in their immediate vicinity.

On account of the large balance available July 1, 1916, due to the river remaining at an unfavorable stage for construction work in 1915 and 1916, the estimate submitted for the fiscal year 1918 has been reduced to \$1,000,000.

It is proposed to expend these funds as follows:

Systematic works of improvement:

Standard revetment-----	\$500, 000
Standard dike-----	420, 000

Maintenance and repair:

Operations of repair party in making necessary repairs to revetments and dikes that have suffered deterioration or injury-----	50, 000
Operations of the snag boat <i>Missouri</i> , including repairs-----	15, 000
Ordinary repairs to floating plant, consisting of 5 towboats, 6 pile drivers, 8 quarter boats, 7 mattress barges, 6 gasoline launches, 40 material barges, and minor pieces-----	15, 000

Total-----	1, 000, 000
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Recommended modification of project.—None.

Commercial statistics.—The commerce reported for the calendar year 1914 shows that 32,760 tons were merchandise, manufactured steel products, grain and feed, of which about 96 per cent was through freight from Kansas City to the mouth. The following table gives a comparative statement of commerce for the calendar years indicated:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	347,235	\$3,929,212
1914.....	240,550	4,677,207
1915.....	216,490	7,516,373

The commerce consisted principally of sand and gravel, grain, manufactured steel, miscellaneous merchandise, live stock, and railroad ties, amounting to 216,490 tons, valued at \$7,516,373.

Amount expended on all projects from 1838 to June 30, 1916:

New work.....	\$11,534,218.09
Maintenance	998,458.42
Total.....	12,532,676.51

Balance available for fiscal year ending June 30, 1917.....	2,139,298.06
Amount (estimated) required to be appropriated for completion of existing project.....	12,600,000.00

Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement.....	935,000.00
For maintenance of improvement.....	65,000.00
Total.....	1,000,000.00

MISSOURI RIVER, KANSAS CITY, MO., TO SIOUX CITY, IOWA.

Existing project.—No definite project based on an examination report has been adopted by Congress for this section of the river, beginning at Kansas City, 392 miles above the mouth, and extending to Sioux City, 415 miles farther upstream. The existing project may be considered as adopted by the river and harbor act of June 13, 1902, which abolished the Missouri River Commission and directed the expenditure of the appropriation made by said act and of the unexpended balances of appropriations heretofore made for the improvement of this section of the river in such manner and at such localities as the Secretary of War may direct. As modified in subsequent acts the existing project now provides for snagging, for bank revetment at certain specified localities, and for such other bank revetment within the limits of the funds provided as, in the judgment of the Chief of Engineers, may be in the interests of navigation. No estimate of cost of the original work and of maintenance has been approved. For latest published maps see page 1987 of Annual Report for 1911.

Condition at end of fiscal year.—The hindrances to easy navigation are snags and shifting shallow channels, for both of which caving

banks found in every bend are answerable. Dikes and revetments have been built in a few of these bends to protect the banks, thereby fixing the channel and at the same time cutting off the supply of snags. The effect of such work is strictly local. Where the great majority of the bends are disregarded, owing to prohibitive expense attached to general improvement, the effect upon the river, as a whole, is unimportant. Removal of snags has been of marked benefit to navigation, as it affects the entire river. While the destruction of snags will never be finished, so long as there are wooden shores to precipitate tree trunks into the stream, yet were snagging to be discontinued the river would soon revert to an impassable state for navigation.

The maximum draft over the shoalest part of this section was 3 feet at mean low water, this depth occurring during the four months preceding the close of the navigation season, November 15. During the remainder of the season the ruling depth fluctuated, but there was not a dependable depth of more than 4 feet over this entire section for any considerable time.

The total expenditures under the existing project up to the end of the fiscal year amount to \$828,770.78, divided as follows:

New work-----	\$479, 296. 60
Maintenance-----	349, 474. 18

Local cooperation.—Special conditions for local cooperation have been imposed by law as follows:

River and harbor act of March 3, 1905, provided that public authorities at St. Joseph, Mo., shall contribute \$50,000 for bank protection along the harbor line, and this amount was contributed and the work completed March 21, 1906, at a total cost of \$100,000.

The river and harbor act approved July 27, 1916, made an appropriation of \$75,000 for improvement of Missouri River at St. Joseph, Mo., subject to the condition that the city of St. Joseph or other agency shall contribute such sum as may be satisfactory to the Secretary of War, which contribution shall not be in excess of two-fifths of the total amount expended by the United States, and in no event to exceed \$50,000.

Upon request of the interests concerned, authority was granted for local cooperation as follows:

Atchison, Kans.—Left bank, mile 448. In 1895 the Government revetted 6,250 feet of river bank near Atchison, Kans., toward which the Chicago & Atchison Bridge Co. contributed materials valued at \$24,450. The work was completed April 10, 1895.

Elwood Bend, Kans.—Right bank, mile 481. Bank protection was approved by the Secretary of War July 25, 1907, on condition that local interests contribute \$50,000. The St. Joseph & Grand Island Railway Co. contributed \$32,500, and the Chicago, Rock Island & Pacific Railway Co. \$17,500. Work was completed June 25, 1909, at a total cost of \$100,000.

Craig, Mo.—Left bank, mile 549. January 5, 1911, the Secretary of War authorized the expenditure of funds contributed by citizens of Craig for bank protection. Work was completed May 25, 1911, at a total cost of \$11,686, of which \$4,492 was contributed.

St. Joseph, Mo.—Left bank, mile 479. October 14, 1911, the Secretary of War authorized expenditure of funds contributed by the Union Terminal Railway Co. for bank protection at St. Joseph. Work was completed December 20, 1911, the amount contributed being \$3,000.

Council Bluffs, Iowa.—Left bank, mile 663. July 10, 1912, the Secretary of War approved an allotment of funds for bank protection at Council Bluffs in cooperation with the Illinois Central Railroad Co. Additional allotments were made in 1913 and 1914. The revetment work and repairs were completed in May, 1915, at a total cost of \$94,405.75, one-half of which was paid by the railroad company. Unexpended balance of contributed funds on hand, \$156.21.

Folsom, Iowa.—Left bank, mile 641. August 23, 1912, the Chief of Engineers approved bank-protection work in the vicinity of Folsom, Iowa, in cooperation with the Chicago, Burlington & Quincy Railroad Co., and on August 22, 1913, approved an extension of the work. The work was completed March 10, 1914, the cost to the railroad company in cash and materials contributed being \$127,250.55.

Opposite Florence, Nebr.—Left bank, mile 672. November 21, 1913, the Secretary of War authorized acceptance of \$5,000 contributed by the Metropolitan Water District, of Omaha, Nebr., for bank protection opposite Florence, Nebr. The revetment was completed March 13, 1914, at a total cost of \$9,896.59, of which \$4,948.30 was paid from contributed funds. Unexpended balance of contributed funds on hand, \$51.70.

Quindaro Bend, Kans.—Right bank, mile 398. In cooperation with the water departments of Kansas City, Kans., and Kansas City, Mo., and with private interests, dikes and revetments were built in Quindaro Bend in 1915, under authority of subproject approved October 20, 1914. The work was completed December 13, 1915, at a total cost of \$13,319.99, of which \$6,503.04 was charged to contributed funds. Unexpended balance of contributed funds on hand, \$996.96.

In addition to the items above enumerated there has been a large amount of work done on this section of the river by private interests without any cooperation on the part of the Government.

Effect of improvement.—The effect of improvement has been to make navigation easier and safer. A small boat line has been in operation between Omaha and Decatur, Nebr., for two seasons, and water transportation between Kansas City and Omaha was initiated in the spring of 1916 by small towboats.

Proposed operations.—With the funds available July 1, 1916, it is proposed to carry on the work as follows:

Repairs to revetment at Bonton Bend.....	\$4, 025
Operation and repairs of snag boat <i>McPherson</i>	5, 000
Care and repair of plant.....	2, 000
Superintendence and office.....	4, 000
Total.....	15, 025

The river and harbor act of July 27, 1916, provided \$50,000 for this improvement and an item of \$75,000 for work at St. Joseph, Mo., contingent on local interests contributing not to exceed \$50,000, which it is proposed to expend as follows:

Bank revetment at St. Joseph, Mo.....	\$125, 000
Operation and repairs of snag boat <i>McPherson</i>	10, 000
Care and repair of plant.....	3, 000
Bonton Bend revetment, repairs.....	4, 000
Belmont Bend revetment, repairs.....	8, 000
Quindaro Bend revetment, repairs.....	1, 000
Council Bluffs revetment, repairs.....	4, 000
Miscellaneous revetment work in the interest of navigation.....	20, 000
Total.....	175, 000

It is proposed to carry on work with the funds estimated as necessary for the fiscal year ending June 30, 1918, as follows:

Operation and repairs of snag boat <i>McPherson</i>	\$18, 000
Superintendence and office expenses.....	4, 000
Care and repair of plant.....	3, 000
Repairs to existing works.....	10, 000
Total.....	35, 000

Commercial statistics.—Ninety-nine per cent of the commercial tonnage reported for the calendar year 1915 was sand, dredged from the

river bed at Kansas City, St. Joseph, and Omaha, and hauled an average distance of 2 miles. The value of this commerce was only 51 per cent of the total traffic, however. Practically all other freight was transported 100 miles by a boat line established in 1915, with terminals at Omaha and Decatur, Nebr. This commerce, which consisted principally of grain, produce, lumber, and other building materials, has been stimulated more by lack of other transportation facilities at Decatur than by the progress of channel improvement. The draft of loaded vessels did not exceed $2\frac{1}{2}$ feet. All commerce for 1913 and 1914 was sand. Commerce of the current year does not differ in character from that of the preceding year, but navigation is showing a broadening tendency, increasing in amount between Kansas City and St. Joseph and between Decatur and Sioux City, so that the first time in several years the whole division is having a certain amount of river trade. The following table gives a comparative statement of commerce for the calendar years indicated:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	115,686	\$39,348
1914.....	96,287	28,237
1915.....	101,822	55,774

KANSAS CITY TO SIOUX CITY, CONSOLIDATED UNITED STATES AND CONTRIBUTED FUNDS.

Amount expended on all projects from Aug. 14, 1876, to June 30,

1916:

New work.....	} \$3, 085, 266. 81
Maintenance.....	
Balance available for fiscal year ending June 30, 1917.....	141, 229. 87
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	35, 000. 00

MISSOURI RIVER, SIOUX CITY, IOWA, TO FORT BENTON, MONT.

Existing project.—The existing project was adopted by the river and harbor act of July 25, 1912, in accordance with report published in House Document No. 91, Sixty-second Congress, first session. It provides for the expenditure of from \$75,000 to \$150,000 yearly for five years in the removal of snags and rocks from the channel and in bank protection within easy boat reach of landings, towns, and railroad crossings between Sioux City, 807 miles above the mouth, and Fort Benton. The river and harbor act approved July 27, 1916, specifically provided that in the interest of navigation and in view of the existing emergency, and to prevent further loss and destruction of property, the sum of \$75,000, or so much thereof as may be necessary, may be expended for bank revetment work at or near the city of Vermilion, Clay County, S. Dak., subject to certain local cooperation. A map of this stretch of river, 1,478 miles in length, accompanies the report cited above. For bank protection standard permeable dikes with foot mattresses and revetments of continuous woven-brush mattresses, with rock-paved upper banks, are used exclusively.

Condition at the end of fiscal year.—Snagging has been conducted with regularity over the entire division of the river since 1891. On the 172-mile portion between Carroll, Mont., and Fort Benton, called the Rocky River, rock dams and dikes have been built to increase the depths of shoals, and the rapids have been cleared of rocks and boulders. Between Carroll and Sioux City dikes and revetments have been placed within easy reach of towns, landings, and railroad crossings, as being the localities where the most pronounced improvement could be effected at relatively small cost. From April to October, inclusive, drafts of 32 inches are practicable to Pierre, S. Dak., 28 inches to Carroll, Mont., and 22 inches to Fort Benton. The total expenditures under existing project up to the end of the fiscal year amount to \$417,808.01, of which \$284,051 has been expended in new work and \$133,757.01 in maintenance.

Local cooperation.—Special conditions of local cooperation have been imposed by law, as follows: The river and harbor act approved July 27, 1916, provided that the city of Vermilion, or county of Clay, S. Dak., or other agencies, shall contribute in money, labor, or materials, an amount equal to 33 $\frac{1}{3}$ per cent of the amount appropriated by said act (\$75,000) for bank-revetment work or other improvement at or near said city.

Upon request of the interests concerned authority was granted for local cooperation as follows:

Williston, N. Dak.—Left bank, mile 1720. August 13, 1908, the Chief of Engineers authorized bank protection at Williston in cooperation with the Great Northern Railway Co., the city, and the United States Reclamation Service. The work was complete March 17, 1910, at a total cost of \$63,910.69, of which \$42,962.63 was contributed in materials and freight charges.

Sioux Point, S. Dak.—Left bank, mile 811. June 14, 1911, the Chief of Engineers authorized bank protection above Sioux City, Iowa, in cooperation with local interests. The work was completed in 1912, at a total cost of \$60,012, of which local interests contributed \$15,342 and certain materials (value not known).

Fort Pierre, S. Dak.—Right bank, mile 1173. On May 12, 1913, a revetment was completed at Fort Pierre under subproject approved January 14, 1913, and repairs were made in 1914. Toward the construction of this revetment the Chicago & Northwestern Railroad Co. contributed about \$3,787 in freight charges.

Mandan, N. Dak.—Right bank, mile 1,453. On March 12, 1914, the Chief of Engineers approved bank protection at Mandan in cooperation with the Northern Pacific Railway Co. The work was completed September 23, 1914, at a total cost of \$39,228, of which the Northern Pacific Railway Co. contributed about \$24,080 in freight charges and materials.

In addition to the items above enumerated, there has been a large amount of work done on this section of the river by private interests without any cooperation on the part of the Government.

Effect of improvement.—Improvement has not resulted in bringing water transportation into competition with the railroads, although it has benefited commercial boats handling the commodities of territory without rail facilities and adjacent to the river.

Proposed operations.—With the funds available July 1, 1916, it is proposed to carry on the work as follows:

Operation and repairs of snag boats <i>Mandan</i> and <i>McPherson</i>	\$10,465.68
Erection of coal sheds.....	4,000.00
Care and repair of plant.....	2,000.00
Superintendence and office expenses.....	4,000.00
Total.....	20,465.68

The funds available will provide for operation of snag boats until about November 1, 1916.

The river and harbor act of July 27, 1916, carried an appropriation of \$125,000 for this improvement, and an appropriation of \$75,000 for work near Vermilion, S. Dak., contingent on local authorities contributing an amount equal to 33 $\frac{1}{3}$ per cent of the latter sum, thus making a total of \$225,000, including the local contribution when made. It is proposed to expend these funds as follows:

Operation and repair of snag boats <i>Mandan</i> and <i>McPherson</i>	\$30, 000
Elk Point revetment, repairs.....	60, 000
Pierre revetment, repairs.....	2, 500
Mandan revetment, repairs.....	1, 000
Emergency and miscellaneous work.....	31, 500
Bank revetment at Vermilion, S. Dak.....	100, 000
Total.....	225, 000

It is proposed to carry on the work with the funds estimated as necessary for the fiscal year ending June 30, 1918, as follows:

Maintenance of existing works.....	\$40. 000
Superintendence and office expenses.....	4. 000
Care and repair of plant.....	6. 000
Total.....	50, 000

Commercial statistics.—Most of the commerce was between North Dakota and South Dakota territory near the river and without railroad connections, and the ports of Williston, Washburn, and Bismarck in the former State and Chamberlain and Running Water in the latter, the chief commodities being grain, manufactured articles, building materials, and coal. The following table gives a comparative statement of commerce for the calendar years indicated:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	40,081	\$1, 973, 758. 76
1914.....	20,913	924, 685. 00
1915.....	17,976	642, 090. 00

Amount expended on all projects from Aug. 14, 1876, to June 30, 1916:

New work.....	\$2, 894, 913. 32
Maintenance	350, 162. 75
Total	3. 245, 076. 07

Balance available for fiscal year ending June 30, 1917.....	220, 465. 68
Amount (estimated) required to be appropriated for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	50, 000. 00

MISSOURI RIVER AT ST. JOSEPH, MO.

Report of the Board of Engineers for Rivers and Harbors, printed in Rivers and Harbors Committee Document No. 5, Sixty-second Congress, second session:

In its report of March 16, 1908, published as House Document No. 824, Sixtieth Congress, first session, referred to in the resolution, the board discussed the question of the necessity of continuing the improvement of the Mis-

souri River at St. Joseph, Mo., to prevent a diversion of the waters of said river through Lake Contrary, and after describing the conditions existing, it expressed the opinion that such work was advisable at an estimated cost of \$150,000, provided local interests contribute one-half that sum, this proviso being based on the apparent benefits which would accrue to the locality. In its report of February 28, 1910, on this same subject, the board adhered to its opinion that the improvement was advisable, and also in the belief that interested parties should bear one-half the cost.

To aid it in its present investigations, the board requested and has received a report from the local officer setting forth present conditions, which is forwarded herewith. It appears from this report that the caving of the bank has continued and that the neck is now 70 feet narrower than at the time of the last report. More extensive caving has taken place in the bend, above and below.

The act of June 25, 1910, appropriated \$75,000 for the work, to be expended on condition that local interests furnish an equal amount. Up to the present time this cooperation has not been obtained, and the district officer states that it is impracticable to secure it. He believes that if no work is done and the river is permitted to enter the lake, it will eventually cost a great deal more than at the present time. The division engineer states that the principal interest of the United States consists in preventing the river from breaking into Lake Contrary, and he recommends that the restriction on the expenditure of the appropriation of \$75,000 be removed, and that the funds be expended in revetting the bank below a point one to two thousand feet above "B" on the map. He states that this will accomplish that part of the work in which the United States is particularly interested, and without additional Federal expense.

While the point referred to by the division engineer has held for several years, it can not be expected to do so indefinitely if the bank is permitted to continue caving above. It is no doubt composed of some tough material, which has been able to withstand the attack of the river up to the present time, but the force against it will increase as the bank recedes, and any work started there would probably be flanked. Experience indicates that it is not advisable to start revetment on the Missouri River in the middle of a bend.

All reports on this subject recognize the justice and propriety of local cooperation in view of the apparent benefits that the improvement would confer upon riparian owners, upon the railroad and trolley line connecting Lake Contrary with the city of St. Joe, and upon the city of St. Joe and the community at large in the preservation of Lake Contrary as a pleasure and health resort. It appears that it is impracticable to secure this local cooperation, and the question presented is whether it is advisable for the United States to do the work entirely at its own expense in the interests solely of navigation. There is at present little or no through commerce on the Missouri River, and the improvement would result in no direct or immediate benefits to navigation. If the general scheme of improvement adopted for the river below Kansas City were extended to St. Joe, the improvement would be of advantage to prospective commerce and would be a logical part of such improvement, and benefits of a substantial nature would result. As an independent or isolated work, the benefits would be indirect and hard to trace and their extent doubtful. It is impossible to predict with any certainty the effect of the river cutting into the lake. It might result in a material local disturbance of the regimen of the river for some years, but this is not certain, and the result may be simply a gradual wearing away of the bank as in recent years and a drainage of the lake. It is by no means certain that the river would then take a course through the several lakes below Contrary. If it did not, the damage done would not exceed that liable to occur in any one of the caving bends on the Missouri River, except in so far as local interests are affected by virtue of their greater value. In view, however, of the doubt existing as to the actual injury to navigation that might follow the further erosion of the bank and the belief that some benefit, even though indirect, would result, the board has twice reported that it thought the United States would be justified in expending \$75,000 toward the project estimated to cost \$150,000, provided the balance was contributed by the local interests to be benefited. It does not believe that general commerce and navigation would be sufficiently benefited to warrant the expenditure of \$150,000 on this improvement, and therefore must adhere to its former recommendation that the improvement is advisable only on condition that other interests than those of the General Government contribute one-half the cost.

The river and harbor act approved June 27, 1916, contained the following provision:

Missouri River: For improvement and maintenance from Kansas City to Sioux City, \$50,000, of which amount at least \$25,000 may be expended for such bank revetment as in the judgment of the Chief of Engineers may be in the interest of navigation; continuing improvement and for maintenance from Sioux City to Fort Benton, \$125,000, of which amount at least \$50,000 may be expended for such bank revetment as in the judgment of the Chief of Engineers may be in the interest of navigation; in all, \$175,000.

Amount (estimated) required to be appropriated for completion of existing project----- \$25, 000

SAN DIEGO HARBOR, CAL.

Location and description.—San Diego Harbor is just north of the United States-Mexican boundary, 102 miles southeast of Los Angeles Harbor and 555 miles southeast of San Francisco Harbor. The harbor is a natural basin separated from the ocean by a sand spit about 10 miles long.

The present complete plan of improvement is as follows:

(a) The construction of an earthen dike to divert San Diego River from San Diego Bay to False Bay.

(b) The construction of a rubble-mound jetty 7,500 feet long along Zuninga Shoal.

(c) Dredging a channel through the outer bar 570 feet wide and 35 feet deep at mean lower low water, and a channel through the middle ground 32 feet deep at mean lower low water, diverging from a minimum width of 900 feet.

(d) Widening the approach to the San Diego municipal pier outside of pierhead lines by dredging to a depth of 32 feet at mean lower low water an area 480 feet wide, northerly of the approach dredged by the city, and maintaining that portion of the latter outside of pierhead lines at the same depth, subject to the condition precedent that the city shall donate to the United States Government 500 acres of tidelands known as Dutch Flats.

The average height of all high waters above the plane of reference is 4.9 feet. For latest published map, see page 3324, Annual Report for 1915.

Condition at the end of fiscal year.—The dike for the diversion of the San Diego River, which is 7,735 feet long and faced on the river side with rubblestone, was completed in 1876 at a cost of \$79,798.72. Repairs to this dike made with later appropriations have brought this cost up to \$87,318.89. Some repairs have also been made by the city of San Diego. A rubblestone jetty 7,500 feet long has been built on Zuninga Shoal. Dredging of the outer bar and middle-ground channels to depths of 35 and 32 feet, respectively, was completed during the fiscal year, providing the increased widths and depths provided for in the project. From information received from the local harbor master, the least depth of water at mean lower low water found by soundings taken at the end of the fiscal year were 30 feet in the middle-ground channel and not less than the project depth of 35 feet in the outer-bar channel. The San Diego River Dike must be strengthened to guarantee its stability. Its failure would have most serious consequences to the harbor. The total ex-

penditure under the existing project is \$826,643.17 for new work and \$68,335.32 for maintenance, a total of \$894,978.49.

Local cooperation.—The recent modification of the project is contingent upon the donation of 500 acres of tideland, known as Dutch Flats, to the United States Government. The city of San Diego has built a concrete pier 800 feet long with warehouse 735 feet long and 72.5 feet wide. It has also built a reinforced concrete bulkhead 2,675 feet long and a temporary bulkhead 6,800 feet long. It has dredged about 1,876,558 cubic yards in excavating a channel 32 feet deep from the main channel to the pierhead line and 35 feet deep on each side of the pier. This work has been done at a cost of \$1,400,000.

Effect of improvement.—The improvement has rendered the harbor available to modern steamships of the greatest draft ordinarily used on the Pacific Ocean, and has afforded the region the benefits of ocean commerce. The harbor in its natural condition could not be used by such vessels.

Proposed operations.—So much of the available funds as is necessary for that purpose will be used to strengthen and repair the dike which diverts the San Diego River into False Bay. It is estimated that approximately \$24,000, exclusive of the recent conditional appropriation, will remain available after the completion of this work. Contingent upon the specified donation of land, dredging of the area of approach to the municipal pier will be begun. It is expected that the work will be completed with the funds appropriated. With the balance remaining available after the completion of the repair of the dike, and with the funds furnished in the estimate submitted in this report, it is proposed to restore the middle-ground channel to its project dimensions if, and when, shoaling therein progresses to such extent as to hamper commerce. The time when such work may become necessary and the amount of dredging required can not be forecast with certainty, but it is believed probable that the work will be necessary prior to the end of the fiscal year 1918, and that it will require the following operations:

Dredging, 200,000 cubic yards, at 20 cents.....	\$40, 000
Administration, superintendence, and contingencies.....	4, 000
Total.....	44, 000

This work will necessitate the appropriation of \$20,000 in addition to the funds now on hand. Local conditions are such that the work, if required, can not be economically executed in part, but demand that it be done under one contract.

Commercial statistics.—The commerce consists principally of lumber, crude oil, and general merchandise.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	631,022	\$55,840,124
1914.....	654,087	60,184,675
1915.....	550,848	55,302,880

All commerce entering the harbor is affected by the improvement. The usual limits of draft are about 23 feet for loaded lumber vessels,

28 feet for oil-carrying vessels, and 30 feet for foreign and inter-ocean commerce. No new lines of transportation have been established during the year. The American-Hawaiian, Luckenbach, and Great Northern Lines have temporarily suspended their operations on account of the abnormal conditions in ocean shipping.

Amount expended on all projects from Aug. 30, 1852. to June 30.

1916:

New work-----	\$981, 346. 85
Maintenance -----	68, 335. 32
Total -----	1, 049, 682. 17
Balance available for fiscal year ending June 30, 1917-----	254, 433. 33
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	20, 000. 00

SAN DIEGO HARBOR, CAL.—NEW PROJECT.

Report of the Chief of Engineers, printed in Rivers and Harbors Committee Document 8, Sixty-fourth Congress, second session:

Referring to letter of December 15, inclosing a resolution of the Committee on Rivers and Harbors of the House of Representatives, dated December 14, 1916, requesting the Board of Engineers for Rivers and Harbors to examine and review the report on preliminary examination and survey of San Diego Harbor, Cal., printed in House Document No. 646, Sixty-fourth Congress, first session, and report whether the present conditions are such as to justify the modification of said project to include area A, I have the honor to inclose herewith the report of the board, dated January 9, 1917, in response thereto.

At the time of the board's former report the dredging of area A was not considered advisable, largely because the city was not then prepared to take up the construction of an additional pier at this locality. As it appears that business interests are now prepared to carry out their part of the general plan, the board is of opinion that the project recommended in its report of January 19, 1916, should be modified to include the dredging of area A to a depth of 32 feet, at an estimated cost of \$85,000, provided that the work shall not be undertaken until assurances satisfactory to the Secretary of War are given that the construction of a commercial pier adapted to economical handling of interstate and foreign commerce will be completed at this locality within a reasonable time.

After due consideration of the information available, I concur in the opinion that the present conditions are such as to justify the modification of said project to include the deepening of area A at an estimated cost of \$85,000.

LOS ANGELES HARBOR, CAL.

Location and description.—Los Angeles Harbor is 453 miles southeast of San Francisco Harbor and 102 miles northwest of San Diego Harbor. The harbor consists of two parts, the outer, or breakwater, harbor (formerly known as San Pedro Harbor) and the inner harbor, formed by the construction of jetties and by dredging (formerly known as Wilmington Harbor).

The present complete plan of improvement is as follows:

Outer harbor: (a) The construction of a breakwater easterly from Point Fermin. (b) Dredging to a depth of 35 feet at mean lower low water an area of irregular shape about 2,300 feet long, with an average width of about 1,200 feet, lying between the 35-foot contour and the pierhead line west of the inner harbor entrance.

Inner harbor: (c) Dredging to a depth of 30 feet at mean lower low water a channel 400 feet wide from the outer harbor up to the

lower end of the wharves, for full width between wharves, up to and including the turning basin 1,600 feet in diameter, a distance of 16,000 feet. (d) Dredging two channels 200 feet wide and 20 feet deep from the turning basin into the east and west basins, with lengths of 9,000 and 5,600 feet, respectively. (e) The construction of a diversion dam and channel for the protection of Los Angeles and Long Beach Harbors.

No further modifications have been made in them.

For latest published map see page 3326, Annual Report for 1915. The average rise of tide above the plane of reference is 5.1 feet.

Condition at end of fiscal year.—Outer harbor: The breakwater has been completed. Its total length is 11,152.5 feet. Dredging the project area to a depth of 35 feet as mean lower low water has been completed, except for a strip on its southwesterly side about 1,300 feet long, averaging about 75 feet wide, and containing about 26,000 cubic yards. This additional dredging is not regarded as urgent. This part of the project is 98 per cent completed. The total amount expended for new work is \$3,366,039.06, and for maintenance \$15,259.23, a total of \$3,381,298.29.

Inner harbor: (c) The original 30-foot project was completed December 14, 1914, except a stretch of about one-half mile near Reservation Point (Deadmans Island), where there remained about 75,000 cubic yards of silt to be dredged. An additional 420,000 yards of silt was deposited in this portion of the harbor during January, 1916. The controlling depth is 29 feet at mean lower low water.

(d) This part of the project is 96 per cent completed. The silt has been dredged from the easterly end of the east basin channel. The westerly end of this channel was dredged to a depth of 30 feet by the city of Los Angeles. The west basin channel is completed to full project depth and width except for 2,450 feet at its northerly end, where it is only 150 feet wide. The controlling depth at mean lower low water in the southwesterly half of the east basin channel is 24 feet, in the northeasterly half it is 2 feet, and in the west basin channel it is 20 feet.

(e) The conditional appropriation was made after the close of the fiscal year.

The amount expended for new work is \$755,634.54 and for maintenance \$125,095.84, making a total of \$880,730.38. The amount expended for the outer and inner harbors is \$4,121,673.60 for new work and \$140,355.07 for maintenance, a total of \$4,262,028.67.

Local cooperation.—The portions of the project designated (a), (b), (c), and (d) were adopted without conditions of local cooperation. The portion (e) for the diversion of silt was adopted with the proviso that before any work is undertaken by the United States assurances satisfactory to the Secretary of War shall be given that the city or county of Los Angeles or other agencies will provide the right of way, defray the cost of necessary roads and bridges, adjust all damage claims, and maintain the improvement after its completion. In the outer harbor the Outer Harbor Dock & Wharf Co. has dredged to 30-foot depth at mean lower low water the westerly side of the east channel, and in the west channel over a width of 600 feet at its northerly end and 400 feet at its southerly end (cost unknown). The city of Los Angeles has deepened the entire east channel to 35

feet at mean lower low water and has dredged 150 feet wide and 35 feet deep southerly therefrom to the 35-foot contour, has bulkheaded and reclaimed 79 acres of land, and has constructed thereon a concrete wharf 2,920 feet long. It has constructed about 2,000 feet of rubble mound breakwater, inclosing an area of about 50 acres, which has been dredged to a depth of 10 feet at mean lower low water for the use of fishing boats, and it has constructed therein 1,600 feet of wharf along the northerly side. It has widened the entrance channel opposite Reservation Point to 550 feet by dredging to 35-foot depth. It has dredged the greater portion of Mormon Island Channel to 30-foot depth and has constructed a wharf thereon 2,050 feet long. It has dredged to 30-foot depth a channel from the turning basin up to and including the Wilmington Basin and constructed 1,000 feet of wharves in Wilmington Basin. It has also constructed bulkheads, transit sheds, warehouses, and roads leading to wharves and has reclaimed large areas of land. This work was done at a cost of \$5,030,805. The Southern Pacific Co. has dredged a slip 1,840 feet long, 250 feet wide, and 30 feet deep, at a cost of \$161,123. The Pacific Wharf & Storage Co. has dredged a slip 2,450 feet long, 250 feet wide, and 30 feet deep, at a cost of \$91,300. The San Pedro, Los Angeles & Salt Lake Railroad Co. has dredged a channel 2,400 feet long, 60 to 100 feet wide, and 20 feet deep in the east basin, and has done other dredging in front of its wharves, at a cost of \$74,911. The Banning Co. has bulkheaded and reclaimed, by dredging in the channels, about 125 acres of land at a cost of about \$200,000. The Consolidated Lumber Co. has dredged a channel 8,500 feet long in the east basin, and in extension thereof, at a cost of \$199,928. All channels dredged are open for the free use of the public.

Effect of improvement.—Foreign commerce has developed, and large vessels deliver freight at this port where formerly it was delivered elsewhere for transshipment to this locality. Twelve years ago lumber formed 95 per cent of the commerce; last year it was but 35 per cent. The volume of the commerce in 12 years has increased 153 per cent.

Proposed operations.—No work is contemplated in the outer harbor. So much of the available funds as is necessary for the purpose will be used to restore the east basin channel to its project dimensions, under the contract entered into. The Government dredge *San Pedro*, now laid up, will be cared for, and inspections necessary for the enforcement of the laws for the protection and preservation of navigable waters made. If no further dredging operations are required through the deposit of silt in the harbor, the funds in hand are sufficient to meet all needs to the close of the fiscal year 1918.

The appropriation of \$75,000 for the maintenance of the harbor carried in the river and harbor act of July 27, 1916, will be held to meet the probable contingency of the shoaling of the harbor through a flood during the rainy season of the winter, 1916–17. The amount of dredging necessary to remove this shoaling can not be certainly forecast. The estimate is based on the following work:

Dredging 1,000,000 cubic yards, at 7 cents-----	\$70, 000
Administration, superintendence, and contingencies-----	5, 000
Total-----	75, 000

On two occasions during recent years the winter floods have deposited silt which required at least the amount of dredging here estimated for the preservation of commerce of the harbor.

Negotiations with local authorities will be begun to obtain the necessary rights of way and assurances that local interests will defray the cost of necessary roads and bridges, adjust all damage claims, and maintain the improvement after its completion. Surveys and plans will be made and contract or contracts for beginning the work will be let. The proceeding is not sufficiently advanced to state definitely where or when construction work will begin, and, therefore, no estimate for the fiscal year 1918 is submitted.

The funds to be furnished under the estimate of \$75,000 submitted in this report are to meet the contingency of the shoaling of the harbor by a second flood during the rainy season of the winter of 1917-18. Until such time as the Los Angeles River is diverted from the harbor the contingency of extensive shoaling must be faced during each rainy season.

Commercial statistics.—The commerce consists principally of lumber, crude oil, and general merchandise. The new lines established are the California South Sea Navigation Co., the Gulf Mail Steamship Co., and the San Diego-Ensenada Line. Numerous ships of other companies have made this a port for occasional calls.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	1,727,876	\$94,266,762
1914.....	1,734,752	76,696,764
1915.....	1,948,034	88,651,408

Amount expended on all projects from Mar. 3, 1871, to June 30, 1916:

New work.....	\$5,751,119.37
Maintenance.....	140,355.07
Total	5,891,474.44
Balance available for fiscal year ending June 30, 1917.....	613,358.61
Amount (estimated) required to be appropriated for completion of existing project.....	615,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	25,000.00

LOS ANGELES HARBOR, CAL.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 896, Sixty-third Congress, second session:

The outer harbor of Los Angeles, formerly known as San Pedro Harbor, has been under improvement by the United States since 1896, while the inner harbor, formerly known as Wilmington Harbor, has been under improvement since 1871. On account of the consolidation of the cities of San Pedro and Wilmington with Los Angeles on August 12, 1909, later appropriations for these works have been made under the name of Los Angeles Harbor. A breakwater 9,265.5 feet long has been constructed in the outer harbor, and under the existing project, adopted by the river and harbor act approved July 25, 1912, dredging is in progress to secure a depth of 35 feet in the area lying between the 35-foot contour in the bay and the pierhead line at the outer

end of the property of the Outer Harbor Dock & Wharf Co. and at the outer end of that part of the city's property which lies just west of the inner harbor entrance. The existing projects for the inner harbor provide for dredging to 30-foot depth at mean lower low water from the entrance up to and including the turning basin, and dredging two channels, 200 feet wide and 20 feet deep, from the turning basin into the east and west basins. In view of the large development of commerce in the past, the increasing population of southern California, and the building of the Panama Canal, the district officer believes that the commerce of Los Angeles will continue to increase and that ships of greater draft will desire to use the harbor. He expresses the opinion that the locality is worthy of further improvement to the extent covered by the following estimates:

(a) Dredging west end of harbor to 35 feet-----	\$183, 000
(b) Reclaiming land near Deadmans Island-----	293, 000
(c) Constructing breakwater on east side of outer harbor-----	410, 000
(d) Widening inner harbor channel-----	277, 000
(e) Dredging channel 300 feet wide and 30 feet deep between the turning basin and entrance to Wilmington Basin-----	175, 000
Total -----	1, 338, 000

The total cost of the proposed east breakwater is estimated at \$639,000, but the cost to the United States would be reduced to about \$410,000, as shown in item (c) above, by the contribution of the remainder by local interests.

The division engineer concurs in general with the views of the district officer regarding the advisability of improvement, though differing from him regarding certain features of the proposed work.

The Board of Engineers for Rivers and Harbors, for reasons fully explained, is of opinion that the only additional improvement now justified at Los Angeles Harbor is the widening of the inner entrance channel north of station 290, increasing from 750 feet at this point to 1,000 feet at station 294, and continuing thence 1,000 feet wide to the turning basin, for which improvement the district officer has submitted an estimate amounting to \$626,000. This work is recommended by the board provided that the local interests shall furnish the land needed for the proposed widening and clear the way for dredging without expense to the United States.

After due consideration of the above-mentioned reports, I concur with the views of the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of Los Angeles Harbor is deemed advisable to the extent of widening the inner entrance channel to 750 feet at station 290, thence increasing to 1,000 feet at station 294, and continuing with this width to the turning basin, at an estimated cost of \$626,000, provided that the United States shall incur no expense for the land required nor for removal of present wharves. The first appropriation should be \$200,000, with contract authorization for the remainder, with a view to the completion of the work in three years. No expenditure for maintenance need be anticipated.

OAKLAND HARBOR, CAL.

Location and description.—This harbor is on the eastern shore of San Francisco Bay, Cal., opposite the center of the city of San Francisco. This harbor is formed by a tidal estuary about 500 feet wide and about 7 miles long, with a natural tidal basin at the upper end.

Existing project.—The existing project, which was adopted by the river and harbor act of June 25, 1910, contemplates a channel 500 feet wide and 30 feet deep at mean lower low water from deep water in San Francisco Bay through Oakland Estuary to Brooklyn Basin, a distance of about 5 miles, 300 feet wide and 25 feet deep around said basin, and 18 feet deep through the Oakland Tidal Canal to San Leandro Bay, a farther distance of $4\frac{5}{8}$ miles. By special stipulation this act provides for putting three highway drawbridges across the tidal canal in condition for operation of draws and transferring them

to local authorities for maintenance and operation. These bridges were built under a prior project and were maintained as fixed bridges out of the general appropriation, but were not operated as drawbridges. The tidal range is 4.8 feet. The total length of the section included in the project is $9\frac{3}{8}$ miles. The approved estimate of cost of the new work was \$1,100,000, with \$25,000 annually for maintenance. (See H. Doc. No. 647. 61st Cong., 2d sess.) The latest published map may be found in the Annual Report for 1911, page 2556.

Condition at the end of fiscal year.—Originally two parallel high stone jetties were built across the shoal at the entrance; dredging was done to increase the tidal prism in Brooklyn Basin; a canal was excavated to connect the harbor with San Leandro Bay to make it serve as an auxiliary tidal basin; and two highway bridges and a railroad bridge were built across the canal. Dredging to deepen and widen the channel was commenced in 1874, and has been continued ever since, with but few interruptions. There has been completed a channel from 300 feet to 500 feet wide and 30 feet deep from deep water in San Francisco Bay to the tidal basin, a distance of $4\frac{3}{4}$ miles; a channel from 200 to 300 feet wide and 25 feet deep around the tidal basin; a channel 250 feet wide and 18 feet deep in the tidal canal up to the Park Street Bridge, and 300 feet wide and 10 feet deep thence to San Leandro Bay, a total distance of $9\frac{1}{8}$ miles. To complete the project there remains the widening of the main channel to 500 feet and depth of 30 feet, widening the channels around the tidal basin to 300 feet and depth of 25 feet, and the completion of a channel 300 feet wide and 18 feet deep through the tidal canal, involving a further excavation of about 2,463,000 cubic yards. The controlling depths at the end of the fiscal year were 24.5 feet up to the tidal basin, 19.5 feet around the tidal basin, and 18 feet in the tidal canal up to the Park Street Bridge and 10 feet thence to San Leandro Bay. The total expenditures under the existing project up to the end of the fiscal year were \$665,743.56 for new work and \$264,500 for maintenance, a total of \$930,243.56. The project is about 75.35 per cent completed at the end of the fiscal year. The three drawbridges across the tidal canal were put in condition for the operation of their draws by electrical machinery, and they have been transferred to local authorities, under a revocable license, for maintenance and operation. This work was completed in the fiscal year 1914. The jetties built under the original project are free from deterioration, due to careful construction and general absence of disturbing factors, and they need no maintenance. The tidal basin and tidal canal, constructed under the same project, are not maintained for tidal scouring purposes, but have been converted into commercial waterways for the use of navigation.

Local cooperation.—The present project was adopted without any conditions being imposed. The city of Oakland has constructed an efficient system of municipal wharves, at a total cost of over a million dollars, including dredging of approaches, and maintains a dredging plant on work in conjunction with the Government work.

Effect of improvement.—The improvement has provided adequate depth and width of channel for present commerce and has made it possible to ship and receive ocean freight without transferring across San Francisco Bay.

Proposed operations.—(a) With the funds available the channel west of Webster Street drawbridge will be dredged by contract to a width of 500 feet and depth of 30 feet, so far as funds will permit. The expenditures will be distributed as follows:

Dredging west of Webster Street drawbridge, 10 months, at \$12,000 per month-----	\$120, 000. 00
Pro rata cost of operation of patrol boat <i>Suisun</i> , 15 months, at \$366.66 per month-----	5, 500. 00
Engineering expenses and contingencies-----	8, 315. 96
Total-----	133, 815. 96

All funds available will accordingly be exhausted by about October 15, 1917.

(b) With the funds contained in the accompanying estimate it is proposed to continue the above work until completed and then widen the channel west of Webster Street drawbridge, as required by the project. The expenditure of these funds will be distributed as follows:

New work: 1,200,000 cubic yards excavation at a rate of 100,000 cubic yards per month, at 16 cents per cubic yard, 12 months, at \$16,000--	\$192, 000
Maintenance:	
100,000 cubic yards excavation in conjunction with the above new work, at 16 cents per cubic yard-----	16, 000
Pro rata cost of operation of patrol boat <i>Suisun</i> , 12 months, at \$366.67 per month-----	4, 400
Superintendence, inspection, and contingencies-----	18, 600
Total-----	231, 000

The deterioration at the end of the fiscal year amounts to shoaling in the previously dredged channels as follows:

	Cubic yards.
Approach in San Francisco Bay-----	176, 700
From San Francisco Bay to the tidal basin-----	1, 235, 650
Within the tidal basin-----	427, 530
Within the tidal canal-----	6, 000
Total-----	1, 845, 880

Commercial statistics.—Of the total commerce reported, about 50 per cent uses the Government improvement, of which 38 per cent pertains to the section between San Francisco Bay and Webster Street drawbridge; 4 per cent to the section between said drawbridge and the tidal basin; 3.3 per cent to the section around the tidal basin; and 4.7 per cent uses the section in the tidal canal. The commerce for the current year consisted of lumber, building materials, fuel oil, coal, automobiles, and general merchandise, and amounted to 2,876,412 short tons, valued at \$411,634,249.

The tonnage for the last three years was as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	3, 413, 980	\$183, 441, 743
1914.....	2, 608, 402	196, 114, 563
1915.....	2, 876, 412	411, 634, 249

The marked increase in valuation is due to increase in value of automobiles carried on ferries, general merchandise, and a few other items.

Amount expended on all projects from June 24, 1874, to June 30, 1916:

New work-----	\$4, 041, 475. 37
Maintenance (for present project only)-----	309, 716. 12

Total-----	4, 351, 191. 49
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Balance available for fiscal year ending June 30, 1917-----	133, 815. 96
Amount (estimated) required to be appropriated for completion of existing project-----	335, 000. 00

Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement-----	192, 000. 00
For maintenance of improvement-----	39, 000. 00

Total -----	231, 000. 00
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RICHMOND HARBOR, CAL.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 515, Sixty-third Congress, second session:

The city of Richmond lies on the eastern shore of the northern arm of San Francisco Bay, about 8 miles north of San Francisco. Adjacent to the southerly frontage of the city there is a wide flat area well suited to the establishment of manufacturing and industrial plants. The improvement desired by the locality is apparently covered by the project presented by the district officer, which provides for an entrance channel 600 feet wide, a basin 1,800 feet wide in front of the area above referred to, and a channel 600 feet wide northerly to the mouth of Ellis Slough. The ultimate depth contemplated is 24 feet, but for the present it is proposed to provide this depth only in the entrance channel and a portion of the inner basin and 20 feet in the remainder of the basin and in branch channel. The estimated cost of the work thus proposed is \$1,757,000, including a training wall on the southerly side of the entrance channel and a dike on the southerly side of the basin. The estimated cost of providing a depth of 24 feet throughout is \$1,975,000. At the time of the submission of the district officer's report on the survey the plans of the city of Richmond contemplated the expenditure of about \$600,000 in construction of harbor works, a portion of which, it was thought, would be available for contribution to the United States to assist in the work of dredging. In that report the district officer, who is also division engineer, expressed the opinion that the locality is worthy of improvement by the United States in accordance with the plan outlined, contingent upon the expenditure or contribution of \$600,000 for harbor purposes by the city of Richmond. In his supplemental report of January 20, 1913, he states that the plans of the city have been greatly extended and contemplate using all of the funds which the city can raise under its bonding power, amounting to \$1,170,000, leaving to the United States the full cost of the work proposed by him. From a resolution passed by the council of the city of Richmond on November 25, 1913, however, it appears that the council will submit to the people of the city a proposition to raise, by bond issues, \$75,000 per year for a period of five years as a special fund for dredging and improvement of the proposed harbor.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated December 30, 1913. At the request of the board a modified plan was presented by the district officer in his supplemental report of December 20, 1913, covering the dredging of the entrance channel and the Ellis Slough Channel 600 feet wide and 24 feet deep, and of a suitable turning basin of the same depth at Point Potrero, omitting the training wall along the entrance channel. The cost of this work is estimated at \$771,000, and if some of the dredged material from the entrance channel were deposited on the south side of the channel to form

the basis of a training wall and the outer face covered with riprap stone the cost would be increased to \$856,000. The board states that the plan now proposed would confer special benefits to the immediate vicinity, would add largely to the taxable property of the city, and would give value to the city land yet to be improved. For these reasons it believes that the locality should contribute toward the improvement not only by providing the necessary works upon the shore but also by contributing to the cost of dredging. The board believes that the United States would be justified in undertaking the improvement of the harbor under the modified project specified above, at an estimated cost of \$856,000, provided that one-half the estimated cost thereof be contributed by the locality.

I concur with the views of the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Richmond Harbor, Cal., is deemed advisable to the extent of providing an entrance channel 600 feet wide, protected by a training wall faced with riprap, a suitable turning basin at Point Potrero, and a channel thence to Ellis Slough, all to a depth of 24 feet, at an estimated cost of \$856,000, provided that local interests contribute one-half the cost of the work, and provided further, that the city of Richmond construct all bulkheads necessary to retain the dredged material and convey to the United States free of cost title to such lands required in the execution of the project as the Secretary of War may decide should be owned by the General Government.

SAN PABLO BAY, CAL.

Location and description.—This waterway is about 10 miles northeast of San Francisco Harbor. It is 12 miles long by 6 miles wide. The Government improvement consists of a channel through it 5 miles long, and a long dike built by the Navy Department to protect the channel.

Existing project.—The existing project was adopted by the river and harbor act of February 27, 1911, and provides for dredging a channel in San Pablo Bay 27,000 feet long, 500 feet wide, and 30 feet deep at mean lower low water, and also includes a Government dredge for maintenance. (See H. Doc. No. 1103, 60th Cong., 2d sess.) This document also includes additional work in Mare Island Strait, etc., at an estimated cost of \$1,007,000, which is being carried out under the direction of the Navy Department. The total estimated cost of the War Department part of the project is \$760,000, \$510,000 of which is for dredging under contract and \$250,000 for the construction of a Government dredge for maintenance. The cost of maintenance is estimated at \$100,000 per annum. The tidal range is 5 feet. The object of the improvement is to permit the large volume of deep-water tonnage to reach the head of navigation and other ports on San Pablo Bay, and also to permit Navy vessels to reach Mare Island Navy Yard. The latest published map may be found on page 3154 of the Annual Report for 1915.

Condition at the end of the fiscal year.—Originally a channel 300 feet wide and 30 feet deep was dredged across Pinole Shoal within the bay, the only obstruction to navigation. This was totally obliterated in a short time. Subsequently a new channel 500 feet wide and 30 feet deep, located more advantageously with relation to the currents was dredged. In addition the Navy Department built a sheet-pile dike 8,500 feet long off the southwest corner of Mare Island for the benefit of this channel, at a cost of \$297,912.20. A sea-going hopper dredge, authorized by the approved project for the maintenance of the channel, has been under construction and is now completed. The controlling depth at the end of the fiscal year is 24 feet at mean lower low water. The original work of dredging was

completed in the fiscal year 1914. The Government dredge for maintenance was completed in the fiscal year 1916. The dike off Mare Island, constructed by the Navy Department, was completed in the fiscal year 1912. The total expenditures under the existing project to the end of the fiscal year were \$747,852.26 for new work and \$11,060.45 for maintenance, a total of \$758,912.71. The War Department portion of the project has been completed for less than the estimate, the amount of the saving being \$50,000.

Local cooperation.—The present project was adopted without any conditions being imposed. Local interests have expended about \$450,000 on public docks, piers, and ferry slips, and about \$90,000 in dredging approaches to those docks, etc.

Effect of improvement.—The improvement has materially increased the commerce of San Pablo Bay points by making it possible for deep-draft ocean vessels to land direct at the desired destination. There is no opportunity for competition with the railroad rates, but the improvement has materially reduced the cost of shipping for this locality. The exact effect on freight rates has not been determined.

Proposed operations.—(a) With the funds available it is proposed to operate the dredge *San Pablo* and the patrol boat *Suisun* by hired labor, as follows:

Operation and repairs to dredge <i>San Pablo</i> , 15 months, at \$8,000__	\$120, 000. 00
Pro rata cost of operation of patrol boat <i>Suisun</i> , 15 months, at \$366.66_____	5, 500. 00
Alterations and changes in dredge <i>San Pablo</i> _____	25, 000. 00
Superintendence, office expenses, and contingencies_____	19, 096. 09
Total _____	169, 596. 09

The funds will be exhausted by September 30, 1917.

Proposed operations.—(b) With the funds contained in the accompanying estimate it is proposed to continue the above work by hired labor during the fiscal year 1918 as follows:

Operation and repairs to dredge <i>San Pablo</i> , seven months, at \$8,000_____	\$56, 000
Pro rata cost of operation of patrol boat <i>Suisun</i> , nine months, at \$366.67 per month_____	3, 300
Superintendence, inspection, and contingencies_____	8, 700
Total _____	68, 000

All of the above work will be for maintenance of the existing project.

Commercial statistics.—There being 19 feet of water prior to improvement only the deepest draft commerce is affected by the improvement, and this amounts to about 60 per cent of the total. Practically all of the commerce reported uses the improved section. The total commerce for the calendar year 1915 amounted to 4,293,517 tons, valued at \$103,795,779, and consisted of fuel oil, grain, sugar, lumber, etc. The total tonnage for the last three calendar years is as follows:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	3, 464, 379	\$110, 373, 436
1914.....	3, 892, 186	115, 044, 008
1915.....	4, 293, 517	103, 795, 779

The commerce for 1915 increased materially, due to natural development and the European war. The valuation is smaller, due to use of a lower schedule of values for commodities.

Amount expended on all projects from June 13, 1902, to June 30, 1916:

New work	\$1, 083, 017. 59
Maintenance	11, 060. 45
Total	<u>1, 094, 078. 04</u>
Balance available for fiscal year ending June 30, 1917	169, 596. 09
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	68, 000. 00

HUMBOLDT HARBOR AND BAY, CAL.

REBUILDING JETTIES.

Location and description.—This locality is 220 miles north of San Francisco and 325 miles south of the mouth of the Columbia River, Oreg. Humboldt Bay consists of two shallow basins, connected by a narrow channel about 5 miles long. The entrance to the bay from the ocean is at the junction of this channel with the southern basin. The bay is an indentation of the coast line; it has a length of 14 miles and an extreme width of $3\frac{1}{2}$ miles, with an average width of three-fourths of a mile.

Existing project.—The existing project, adopted by the river and harbor act of June 25, 1910, provides for rebuilding the two jetties at the entrance which were originally built under a prior project and worn down by storms and wave action. The object is to confine and direct the current so as to scour a channel about 500 feet wide and 30 feet deep across the bar. The mean tidal range is 4.3 feet, with an extreme range of 11 feet, and there is no material difference in the tidal range at different points. The length of the jetty channel is $1\frac{5}{8}$ miles. The approved revised estimate of cost of original work is \$1,737,400, with no approved estimate of cost of maintenance. (See H. Doc. No. 950, 60th Cong., 1st sess.) The latest published map may be found in the Annual Report for 1900, page 4246, but it does not pertain to the present project.

Conditions at the end of fiscal year.—Originally two parallel jetties were built at the entrance, extending out to the 18-foot contour, a distance of about 5,000 feet from the shore. These jetties were beaten down by heavy seas and their effective outer ends practically obliterated. The reconstruction of these jetties on a much more substantial scale was begun in 1911, and so far the south jetty has been completed and the north jetty extended a distance of 2,638 feet, or about five-eighths of its ultimate length, there being 4,220 linear feet of enrockment in the jetty. At the end of the fiscal year the approved project was about 72 per cent completed. The work done on the south jetty has greatly improved the entrance channel, making it 7 feet deeper than in 1911 and straighter out to sea, and reducing the distance across the 30-foot shoal from 3,500 feet in 1911 to 600 feet in June, 1916. During the last winter the shoals between the jetties increased to such an extent as to endanger the narrow channel to sea. It is expected that the completion of the north jetty

will entirely remedy this obstruction. The controlling depth at the end of the year was 23 feet at mean lower low water. The expenditures under the existing project were \$1,321,297.58 for new work and \$224,694.26 for maintenance, making a total of \$1,545,991.84.

Effect of improvement.—The general result of this improvement has been to materially reduce freight rates, but, due to shortage of vessels incidental to the present European war, freight rates have increased during the past year almost 100 per cent on the chief items of freight. The development of commerce at this port has greatly stimulated railroad construction into the interior undeveloped territory commercially tributary to this waterway.

Proposed operations.—With the funds available it is proposed to continue placing stone in the north jetty, obtaining the stone under contract and placing it by hired labor. The normal and most economical rate of delivery at this season of the year is about 1,000 tons per day, with existing plant and equipment, and the cost averages about \$2 per ton placed in the jetty.

The above work and also the necessary repair work to both jetties will be prosecuted at the normal summer rate until stormy weather sets in, when the rate of delivery will be cut down. Work will be continued at the reduced rate throughout the winter months, and upon the beginning of good weather in the spring the full rate of delivery will be resumed, viz:

Nine months of full operations, at \$45,000 per month.....	\$405, 000
Three months of reduced operations, at \$15,000 per month.....	45, 000
Total for 12 months.....	450, 000

With the funds to be furnished under the estimate submitted it is proposed to continue work on the north jetty and to repair damages to both north and south jetties by storms, etc.

Commercial statistics.—The total commerce of the locality is affected by the improvement, and all of the commerce uses the improved section. Lumber shipments furnish the bulk of the tonnage, and they show a decrease of about 25 per cent from the previous year. This loss was due largely to the European war and partly to competition from the newly constructed railroad connecting with San Francisco. Besides lumber, the chief items of freight are general merchandise, fuel oil, and dairy products.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	829, 406	\$16, 572, 257
1914.....	818, 458	37, 596, 294
1915.....	599, 255	26, 572, 233

Amount expended on all projects from 1884 to June 30, 1916:

New work.....	\$3, 500, 001. 72
Maintenance.....	224, 694. 26
Total.....	3, 724, 695. 98

Balance available for fiscal year ending June 30, 1917.....	454, 303. 22
Amount (estimated) required to be appropriated for completion of existing project.....	195, 700. 00

Amount that can be profitably expended in fiscal year ending
June 30, 1918:

For works of improvement.....	190, 500. 00
For maintenance of improvement.....	180, 500. 00
Total.....	371. 000. 00

CRESCENT CITY HARBOR, CAL.—NEW PROJECT.

Report of the Chef of Engineers, printed in House Document 434,
Sixty-fourth Congress, first session:

Under authority of the act of February 27, 1911, a preliminary examination was made of Crescent City Harbor, and in the report thereon, printed in House Document No. 720, Sixty-second Congress, second session, it was recommended that a new investigation be authorized covering Crescent City Harbor and vicinity. The points in the vicinity of Crescent City which have been suggested as possible harbor locations are Point St. George (or Wooleyport), Preston Island, and Lakes Earl and Talawa. As a result of his investigations the district officer reaches the conclusion that the best natural harbor, and the one that could be most easily and economically improved and extended, is at Crescent City. It is well protected from all points north of west, but is open to the southwest. A plan of improvement is proposed by the district officer contemplating a breakwater extending from Battery Point to Fauntleroy Rock, and a jetty or sand barrier from Whaler Island to the high-water beach line, the entrance to be between Fauntleroy Rock and Whaler Island. The area protected would be 460 acres at high water, and 361 acres at mean lower low water, of which 239 acres have a depth of 12 feet or more, 148 acres a depth of 18 feet or more, and 81 acres a depth of 24 feet or more at mean lower low water. The estimated cost of these structures is \$1,828,750. Local interests have indicated their willingness to contribute toward the improvement the sum of \$250,000, which appears to be the limit of their resources.

The commerce now existing at this locality is small and without improved transportation facilities would no doubt remain so. There is no other harbor along this coast for a distance of 100 miles in either direction. The district officer, who is also the division engineer, states that the timber, mineral, and agricultural resources of northern California and southern Oregon are seeking an outlet at this point and the construction of a connecting railroad will, in all probability, follow or accompany the creation of a harbor. He expresses the opinion that the locality is worthy of improvement by the United States to the extent indicated, at a total initial cost to the United States of \$1,578,750 for construction, and a maintenance cost averaging \$35,000 per year for four years, provided that an additional sum of \$250,000 be contributed toward the work by local interests.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated November 10, 1915. For the consideration of the board, additional estimates of cost were secured from the district officer, and are contained in his supplemental reports of May 15, 1915; July 14, 1915; and September 13, 1915. It is estimated that a harbor having a protected area of about 600 acres with depth not less than 24 feet would cost from \$5,833,000 to \$8,064,000, depending upon the type of construction, while a breakwater along the line A to C, indicated on the accompanying map, would cost \$490,000. This latter breakwater would afford considerable protection and later form part of a greater project, if the commercial growth following its construction should indicate the need of increased facilities. The board believes that a safe harbor on this section of the coast would be of material advantage to the existing commerce and would encourage further development. It would also be of value to general navigation on the north Pacific by affording a place of refuge for vessels in distress. As a commercial harbor, however, its success is dependent upon the existence of suitable connections with the tributary country, whose resources are expected to form the basis of its future commerce. A railroad has been commenced from Grants Pass, Oreg., to Crescent City, and conditioned upon the assurance that this railroad will be completed within a reasonable time, the board believes that it is advisable for the United States to undertake the improvement of Crescent City Harbor by the construction of a breakwater, at an

estimated cost of \$490,000, approximately as shown on the map by the line AC, with a possible extension approximately on the line CD, if funds will permit; provided that local interests shall contribute \$100,000 toward the work, and shall furnish, free of cost to the United States, such land as may be required for the operations of the Government in connection with this project.

After due consideration of the above-mentioned reports I concur in the views of the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Crescent City Harbor, Cal., is deemed advisable to the extent of constructing a breakwater approximately on the line AC indicated on accompanying map, at an estimated cost of \$490,000, with a possible extension approximately on the line CD, if funds will permit; provided that before work is begun by the United States assurance shall be given, satisfactory to the Secretary of War, that the projected railroad between Crescent City, Cal., and Grants Pass, Oreg., will be completed within a reasonable time; and provided further, that local interests shall contribute \$100,000 toward the work, and shall furnish, free of cost to the United States, such land as may be required for the operations of the Government in connection with this project.

MOKELUMNE RIVER, CAL.

Location and description.—The Mokelumne River rises near the crest of the Sierra Nevadas and flows southwesterly 119 miles to the town of Woodbridge; thence northerly about 9 miles to the Galt-New Hope Bridge; thence northwesterly, westerly, and southerly 8 miles by river to New Hope Landing, where it separates, afterwards reuniting below in a southerly direction 9 miles via North Fork and 14 miles via South Fork (forming Staten Island). The river then flows southerly 4 miles and empties into the San Joaquin 20 miles above the mouth of the latter at Suisun Bay, a total distance of 140 miles via North Fork or 145 miles via South Fork. The river lies generally about midway between the cities of Sacramento and Stockton.

Existing project.—The existing project was adopted by river and harbor act of July 5, 1884. It has for its object to maintain a channel suitable to the needs of navigation by means of removal of snags and obstructions and occasional dredging of shoals.

Conditions at the end of fiscal year.—No survey has been made, but it is believed that there exist the governing depths tabulated above under existing project, reference to which is made to avoid extensive repetition here. The channel is believed to be free of obstructions to the head of navigation. Total expenditures to end of fiscal year are \$30,797.49, of which \$21,402.05 was for new work and \$9,395.44 for maintenance.

Local cooperation.—There are no local cooperative requirements of current interest, nor were there any at the time of adoption of the project. Two appropriations of \$2,500 each in river and harbor acts of 1892 and 1894 stipulated that none of the money appropriated should be spent until a private drainage canal near New Hope Landing "shall have been closed." (Annual Report for 1895, p. 3298, states that the condition was complied with.) About 1904 (Annual Report, 1905, p. 2431) the State of California spent \$10,000 and private parties claimed to have spent \$40,000 on improvement. About 1910 (Annual Report, 1911, p. 2562) the State of California spent \$22,782.39 on improvements. Some work was done about 1911 by private parties. (Annual Report, 1912, p. 2781.)

Effect of improvement.—The improvements have made possible regular scheduled steamboat operation to the Galt-New Hope Bridge. The effect upon transportation costs could be stated only after such extended investigation as is impracticable, but is presumably one of reduction. Development of the delta country contiguous to the river is doubtless due considerably to improved transportation conditions, as boats at present furnish the most practicable means of freight transportation.

Proposed operations.—Funds available will be expended in removing shoals and snags as they appear, and will probably be expended in one short period of operations some time before June 30, 1917. No funds are, however, asked for, as it is not probable work thereafter will be required until there has been time for further appropriation estimate.

Commercial statistics.—The commerce for the calendar year 1915 amounted to 88,711 short tons, valued at \$4,200,675, of which barley was about 24 per cent; beans, 5 per cent; potatoes, 38 per cent; other vegetables, 6 per cent; and general merchandise, 16 per cent. (See San Joaquin River commercial statistics.)

Financial summary.

Amount expended on all projects from July 5, 1884, to June 30, 1916:

New work-----	\$21, 402. 05
Maintenance-----	9, 395. 44
Total-----	30, 797. 49
Balance available for fiscal year ending June 30, 1917-----	702. 51

(See letter appended to item for Sacramento River containing supplemental estimate for this project.)

PETALUMA CREEK, CAL.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 118, Sixty-third Congress, first session:

The existing project for the improvement of Petaluma Creek provides for dredging a channel 6 feet deep and 50 feet wide from the mouth in San Pablo Bay, San Francisco Harbor (to which point boats drawing 8 feet can easily be brought at low water from the ocean), to McNears Canal, and 4 feet deep and 50 feet wide thence about 3,300 feet to the head of navigation at Petaluma, about 15 miles from the mouth of the creek. At the time of the adoption of this project the depth in the channel across the flats in San Pablo Bay was ample for the needs of commerce, but the district officer, who is also division engineer, states that this channel later became obliterated. A channel approximately 150 feet wide and 8 feet deep at mean lower low water was dredged across the flats in 1912; but some shoaling has since taken place, and as the improved channel in Petaluma Creek will be of little value without the maintenance of this approach channel the district officer recommends that the existing project be so modified as to include the maintenance of a channel across the flats 100 feet wide and 8 feet deep at mean lower low water. The estimated cost of maintaining the existing project with this modification is \$7,500 per year.

I concur in general with the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore, in carrying out the instructions of Congress, I report as follows: That the improvement by the United States of Petaluma Creek, Cal., with a view to securing increased depth at the mouth in San Pablo Bay, is deemed advisable so far as to maintain an available channel depth of 8 feet and a channel width of 100 feet across the flats at the mouth of the river, in connection with the maintenance of the existing project for improvement of Petaluma Creek, at a total estimated cost of \$7,500 annually.

NAPA RIVER, CAL.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 795, Sixty-third Congress, second session:

Napa River extends from Mare Island Strait to and above the city of Napa and is navigable to said city, a distance of 18 miles. The existing project for the river is to maintain a channel 75 feet wide and 4 feet deep at mean lower low water and to remove trees, snags, logs, etc. In the prosecution of the work it has been found impracticable to limit the dredging on the bars to that depth with clamshell dredges, and owing to overdepth dredging, depths of 6 feet have generally been secured, which has permitted boats to load to a draft of 5 feet or more. For these reasons the district officer, who is also division engineer, believes that a depth of 6 feet with 1 foot overdepth should be provided in any cut-offs to be made by the United States. He states that there are four bends where cut-offs would be of value to navigation, the localities being designated as Jacks Bend, Spreckels Point, Car Bend, and Horseshoe Bend. The bottom widths proposed are 60 to 100 feet and the total estimated cost is, in round numbers, \$43,000. He states that the necessary rights of way will be furnished by the city of Napa, and as these lands are improved and valuable, their cost constitutes a considerable contribution toward the expense of the proposed improvements. No further cooperation has been offered by local interests. He is of opinion that the locality is worthy of improvement to the

extent and in the manner indicated, provided that the lands necessary for the cut-offs and for the dumping grounds are furnished free of cost to the United States.

I concur with the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of Napa River, Cal., is deemed advisable to the extent of making four cut-offs, as shown on accompanying map, 6 feet deep at mean lower low water and with widths as proposed by the district officer, at a total estimated cost of \$43,000, provided that no expense shall be incurred by the United States for acquiring any lands required for the purpose of this improvement. The first appropriation should be \$20,000 for work on Jacks Bend, Spreckels Point, and Car Bend, the balance of \$23,000 to be appropriated when the necessary right of way and dumping ground for the cut-off at Horseshoe Bend have been furnished the United States free of cost.

SAN RAFAEL CREEK, CAL.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 801, Sixty-third Congress, second session:

San Rafael Creek is a narrow slough about 2 miles in length emptying into San Francisco Bay. At the head of the creek is the town of San Rafael. The stream has been improved by the State of California and by private interests, but no work has been done by the United States at this locality. The existing depths at mean lower low water vary from zero on the tide flats off the mouth of the creek to 1 or 2 feet in the creek channel, and navigation is possible only at the higher stages of the tide. Deep water in San Francisco Bay is found at a distance of $1\frac{1}{2}$ miles from the mouth of the creek. The district officer, who is also division engineer, submits a plan of improvement contemplating the dredging of an outer channel 100 feet wide at bottom and 8 feet deep, a channel in the creek 60 feet wide at bottom and 6 feet deep, with a cut-off at Goose Neck, and a turning basin 6 feet deep, 200 feet long, and 100 feet wide, all at an estimated cost of \$54,600. It appears that the locality is willing to bear one-half of the cost of the proposed improvement, and in view of this cooperation and the benefits to commerce to be expected the district officer deems the locality worthy of improvement to the extent and in the manner above stated.

I concur with the views of the district officer and the Board of Engineers for Rivers and Harbors that the improvement by the United States of San Rafael Creek, Cal., is deemed advisable to the extent of providing a channel 8 feet deep at mean lower low water and 100 feet bottom width across the flats at the mouth of the creek, and a channel 6 feet deep and 60 feet bottom width in the creek, including a cut-off at Goose Neck Bend and a turning basin 200 feet long, 100 feet wide, and 6 feet deep, at an estimated cost of \$54,600, provided local interests contribute one-half of this amount and that no expense shall be incurred by the United States for acquiring any lands required for the purpose of this improvement.

IMPROVING SACRAMENTO AND FEATHER RIVERS, CAL. (GENERAL IMPROVEMENT).

Location and description.—The Sacramento River is formed by the junctions of numerous tributaries draining the Trinity and Warner Mountains in northern California, the principal component streams being the McCloud, Fall, Pit, and Sacramento proper. From the junction of the Pit and the Sacramento proper—the lowest of these junctions—the Sacramento River flows about 320 miles in a southerly direction and empties into the Suisun Bay at Collinsville.

The Feather River heads on the crest of the Sierra Nevadas, flows in a southwesterly course, and empties into the Sacramento River about 20 miles (by river) above Sacramento.

Existing project.—The Sacramento River is navigable from Red Bluff to its mouth, a distance of 253 miles, and this is the section in-

cluded in the project. The lower 30 miles of the Feather River, from Marysville to its mouth, is navigable.

Sacramento River is being improved under plans adopted as follows:

Below Sacramento, with a view to securing a least channel depth of 7 feet by means of a system of wing dams at or near shoals, supplemented by dredging, if necessary, at an estimated cost of \$280,000, adopted by the river and harbor act approved March 3, 1899, in accordance with the reports printed in House Document No. 186, Fifty-fifth Congress, second session, and House Document No. 48, Fifty-fifth Congress, third session. For latest published map of this section of the river see House Document No. 1123, Sixtieth Congress, second session.

Above Sacramento, with a view to securing a channel 4 feet deep up to Colusa, 3 feet deep from Colusa to Chico Landing, and such depth as is practicable from Chico Landing to Red Bluff, at an estimated annual expenditure of \$25,000, adopted by the river and harbor act approved July 25, 1912, in accordance with the report printed in House Document No. 76, Sixty-second Congress, first session. For latest published map of this section of the river see House Document No. 1123, Sixtieth Congress, second session, and House Document No. 76, Sixty-second Congress, first session.

In the report printed in House Document No. 48, Fifty-fifth Congress, third session, a board of engineers expressed the opinion that no permanent improvement of the Feather River could be carried out at reasonable or justifiable cost until the flow of sand and other mining detritus had been stopped. Since this report in 1899 no work has been done for the improvement of Feather River. In the river and harbor act approved July 27, 1916, an appropriation of \$10,000 was made for work on Feather River, subject to the condition precedent that local interests contribute a like sum toward the improvement.

The tidal range is 6 feet at the mouth of Sacramento River and during extreme low water about 1 foot at Sacramento.

Condition at the end of the fiscal year.—At the end of the fiscal year wing dams for obtaining and maintaining the project depths had been built and were being maintained at practically all the shoals below Sacramento. During some years it had been necessary to supplement the action of the wing dams by dredging at low-water stage. Snags had been removed from the river each year, and this year's work of removing snags was being carried on. As the project is for maintaining certain navigable depths, the proportion of the existing project accomplished at end of year is not determinable. With a gauge reading of 16 feet or over at Sacramento, vessels drawing 14 feet can be taken to Sacramento. With a gauge reading of 6 feet or over at Colusa, vessels drawing 8 feet can be taken to Colusa. With a gauge reading of 5 feet or over at Chico Landing, vessels drawing 5 feet can be taken to Chico Landing. And with a gauge reading of 5 feet or more at Red Bluff, vessels drawing 4 feet can be taken to Red Bluff. With a gauge reading of 5 feet or more at Marysville, vessels drawing $3\frac{1}{2}$ feet can be taken to Marysville. These gauge readings are usually obtainable from January 1 to May 1. On the Sacramento River, the project depths of 7 feet up to Sacramento, 4 feet up to Colusa, 3 feet up to Chico Landing,

and about 2 feet from Chico Landing to Red Bluff are available, and on the Feather River a depth of about 2 feet is available. These are the maximum drafts which may be carried over these portions of the rivers at low stages of the rivers. Up to the end of the fiscal year \$433,886.83 had been expended on the existing project, of which \$37,212.71 were for original work and \$396,674.12 for maintenance.

Local cooperation.—Voluntary local and State cooperation has been quite extensive. The State of California has done extensive bank-protection work, built wing dams, made cut-offs, and done various other river work. The cities of Sacramento and Marysville have built municipal wharves and freight sheds, and reclamation districts have dredged much material from the river for levees, to the material aid of navigation. It is estimated that this work has amounted to approximately \$3,950,000 on these two rivers. In the river and harbor act approved July 27, 1916, an item of \$10,000 for work on Feather River was made, subject to the condition precedent that local interests contribute a like sum toward the improvement.

Effect of improvement.—The effect of improvement is that there is continuous navigation upon the Sacramento River from its mouth to Chico Landing. To Sacramento there are four daily (except Sunday), one weekly, and two semiweekly steamers from San Francisco. To Colusa there are four weekly steamers and to Chico Landing there is one weekly steamer from San Francisco. There is also a gas passenger launch daily each way between Sacramento and Antioch and Stockton. Besides these boats making regular trips there are numerous steamers, towboats, and launches and barges plying upon the river as occasion demands. The direct effects upon rates (either land or water) resulting from the improvement and the direct effect upon rail rates of the water charges are quantitatively indeterminate. However, it is known that the State railroad commission does take into account water competition in fixing railroad rates.

Proposed operations.—With the funds available it is proposed to maintain the project depths in the Sacramento River by snagging, building wing dams at shoals, and by occasional dredging; also to construct a necessary new snag boat; and to pursue similar work on the Feather River, as required by the recent act providing the funds. The exact rate of expenditure will depend somewhat upon the meeting of cooperative requirements similarly thus introduced and can not be foretold. Except as to the funds which must be reserved for this, however (\$10,000), the expenditure will probably be at the rate of \$33,000 for field work for the balance of this working season, \$60,000 for the new snag boat within the next year, and \$10,000 for the next working season until July 1, leaving an expected balance of \$20,000 at that time. For the fiscal year 1918 there will be required an additional appropriation of \$20,000 to provide the sum of \$40,000 for the year's expenses.

The estimated expenditures for the fiscal year 1918 are as follows:

Dredging, below Sacramento	\$3, 000
Operations of snag boat, below Sacramento	3, 500
Repairs and additions to wing dams, below Sacramento	13, 000
Dredging, above Sacramento	1, 000
Operations of snag boat, above Sacramento	18, 000
Repairs and additions to wing dams, above Sacramento	1, 500
Total	40, 000

Commercial statistics.—The commerce on the Sacramento River consists mostly of grain, lumber, fruit, vegetables, rice, and general merchandise. And during the year 768,891 tons, valued at \$34,-309,085, passed over this waterway. Following is a comparative statement of the amount and value of the commerce for the last three calendar years:

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	733,594	\$35,856,791
1914.....	721,090	38,211,760
1915.....	768,891	39,309,085

Amount expended on all projects from Mar. 3, 1875, to June 30, 1916:	
New work	\$37,212.71
Maintenance	396,674.12
New work and maintenance.....	740,860.21
Total.....	1,174,747.04
Balance available for fiscal year ending June 30, 1917.....	133,695.03
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement and for maintenance.....	20,000.00

SACRAMENTO AND MOKELUMNE RIVERS, CAL.—SUPPLEMENTAL ESTIMATES.

WAR DEPARTMENT,
THIRD SAN FRANCISCO ENGINEER OFFICE, UNITED STATES ARMY,
AND CALIFORNIA DÉBRIS COMMISSION,
San Francisco, Cal., December 8, 1916.

From: The District Engineer Officer, Third District, San Francisco, Cal.
To: The Chief of Engineers, United States Army, Washington, D. C.
(Through the Division Engineer, Pacific Division).
Subject: Appropriations.

1. In view of the fact known that there is made available to the Chief of Engineers by the committees of Congress opportunity to revise, in informal conference, estimate for ensuing fiscal year river and harbor appropriation, to cover conditions that may have involved change, and that calls to the field based thereon for later information (especially during short congressional session) are sometimes submitted on such short notice that telegraphic communication is inadequate to cover the matter, and offices at this distance in time are at disadvantage in submitting adequate mail substantiation of the case, it is desired to present the following requested revision of estimates for works in this district:

First. Mokelumne River: At the time of submission of estimate it was presumed that, though possible additional work to use up funds then on hand (about \$600) would be needed this season (now passed), we probably could get along until next year without work, in accordance with the usual recent experience showing alternate years' work was adequate. However, it was found necessary to do work this year, exhausting the funds without doing all that was needful; and, further, it is found that \$1,000 for similar work available next year is necessary.

Second. Sacramento River (general improvement): An increase of \$10,000 over the amount of original estimate is requested, for the following reasons: First, because we have had to spend about \$1,000 on restoring a wing dam specially destroyed, and which we had not counted on having to do, recovery of which from injuring party is at best dubious (vi. E. D. 102627/3, dated Sept. 28, 1916—my Sac. 33/46); second, unexpected sinking of pile driver cost about \$500 more than recovery seems probable (vi. E. D. 103032, dated Oct. 28, 1916—my P. 1/434); third, owing to favorable working season on part of river

with long low water we were enabled, and compelled, to spend more money during the past calendar year (which is the working season) than during the two previous seasons, as is shown by the following comparative figures:

Amount expended during the calendar year 1914-----	\$31,928.43
Amount expended during the calendar year 1915-----	39,258.57
Approximate expenditures for calendar year 1916-----	42,400.00

Fourth, owing to generally increasing costs of our principal supplies and labor, not only has the latter portion of our work for this year cost more per job than expected, but that that for next year promises to be even more expensive; fifth, owing to the delay in new snag boat (vi. my fourth indorsement, p. 2, dated Sept. 28, 1916, on your E. D. 98622/6, of July 31, 1916—my P. 3/583), repairs to the old snag boat have become imperative, an expense which it had been expected could be obviated; sixth, owing to changing conditions on the river (i. e., increasing reclamations), the satisfactory disposal of snagged obstructions is becoming more expensive; seventh, the present appearances are that, particularly as accentuated by the increasing cost of materials, the new snag boat will cost more than has been anticipated, especially if its completion is at such a season of the year that we can not dispense with the old one for the time needed to effect exchange and installation of some of the old plant on the new, particularly as with the repairs that will have then been put on the old it will be worth keeping in use for a while longer: i. e., some of the increases asked on this account will be more than offset in later years; eighth, a casualty which involves the payment under compensation laws of \$1,000 for no return in work, so large a percentage that it can not be absorbed (vi. E. D. 91518/159, of Aug. 9, 1916—my M. 31/199).

L. H. RAND,
Major, Corps of Engineers.

[First indorsement.]

OFFICE DIVISION ENGINEER, PACIFIC DIVISION,
San Francisco, Cal., December 9, 1916.

To the CHIEF OF ENGINEERS UNITED STATES ARMY:

1. Concurring in the views of the district officer.

THOS. H. REES,
Colonel, Corps of Engineers, Division Engineer.

ALLEVIATION OF DÉBRIS CONDITIONS IN THE SACRAMENTO AND FEATHER RIVERS, CAL.

Location and description.—The work being done is from the mouth of the Sacramento River, in Suisun Bay, Cal., at Collinsville, about 45 miles from San Francisco, to Rio Vista, 14 miles above. For description, see report relative to improvement of Sacramento and Feather Rivers, Cal., under the Sacramento-Feather River Board.

Existing project.—The construction and 56 months' operation of two hydraulic dredges for removal of deposits from the river system to prevent their impeding navigation, no definite results in depth, width, or locality having been established. It is based on the annual report of the California Débris Commission for 1907, as printed on pages 2253–2269, Chief of Engineers Annual Report for that year. The approved estimate of cost was \$800,000, half of which was to be provided by local interests. The report was adopted in the river and harbor act of June 25, 1910. Changed conditions between the time of proposal and adoption of report have made it necessary to increase estimate for completion to \$1,660,000, exclusive of cost of necessary spoil banks and maintenance. Tidal variations are as given above. No map particularly applying to this project has been published. The latest published map of the locality will be found in House Document No. 81, Sixty-second Congress, first session.

Condition at the end of the fiscal year.—One dredge has now operated for 29.2 months, the other for 32.3 months, which is 54.9 per cent of the 112 months single-dredge operation contemplated. Up to June 30, 1916, there have been excavated from the Sacramento River 16,828,706 cubic yards of material. From Rio Vista to Three-mile Slough the channel has been enlarged by an average width of 320 feet and a depth of 27 feet for a distance of 15,600 feet, and the old levee on the north side has been removed. From Three-Mile Slough to Bakers Point excavations 250 feet in width, 27 feet in depth, and 9,400 feet long have been made across the "horseshoe," and the levee on the rim at Bakers Point has been breached. Above Collinsville the channel has been enlarged by an average width of 100 feet and a depth of 27 feet for a distance of 4,800 feet; the north side of the channel has been excavated to a depth of 27 feet and a width of 250 feet for a distance of 14,000 feet. Old levees on the north and south side of the channel have been breached, and 2,801,348 cubic yards of material have been removed from the south side of the channel and placed on Sherman Island. The total expenditures under the existing project up to the end of the fiscal year have been \$1,100,470.06, none of which has been for maintenance. Of this amount \$550,833.19 has been from United States funds and \$549,636.87 from funds contributed by the State of California.

Local cooperation.—The act of June 25, 1910, provided that the expenditure of the appropriation for this project should be contingent on the appropriation of an equal amount by the State of California, and furthermore that all rights of way for levees and spoil banks should be furnished free of cost to the United States. The necessary approval of compliance with these conditions as a condition precedent to starting field operations was given by the Secretary of War in 1913. The \$400,000 was deposited for Federal expenditure. It is understood local interests subscribed \$260,000, aided by the State and city of Sacramento in procuring land and easements for spoil banks, etc., which they have transferred to the United States. The State has further deposited \$200,000 to match equivalent funds made available by the Federal Government. Aside from conditions imposed by law, the State has constructed a retaining embankment for spoil deposit at a cost of \$12,400, and has further funds available to match further appropriations.

Effect of improvement.—It is not practicable to claim any definite specific results as solely consequent to this operation, but the general improvement noted in those matters which it was meant to affect, is believed to follow, at least in part, therefrom.

Proposed operations.—Proposed operations are to continue the dredging as outlined above under the project exposition, with both dredges and attendant plant; the funds in hand will be expended at about the rate of \$21,500 per calendar month, and operations with the funds available will last until about July 1, 1917. To continue the dredging operations during the fiscal year 1918, at the slightly increased monthly cost resulting from older plant, will require the provision of \$265,000 in excess of funds now available, of which it is expected the State of California will provide one-half, leaving \$132,500 to be provided by Congress.

Commercial statistics.—See commercial statistics, Sacramento River.

Amount expended on all projects from June 25, 1910, to June 30, 1916:

New work-----	\$1, 100, 470. 06
Maintenance-----	
Balance available for fiscal year ending June 30, 1917-----	204, 162. 05
Amount (estimated) required to be appropriated for completion of existing project-----	311, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement-----	265, 000. 00

ENTRANCE TO COOS BAY AND HARBOR, OREG.

Location and description.—Coos Bay is an indentation in the Pacific coast, in Oregon, about 200 miles south of the mouth of Columbia River and 445 miles north of San Francisco Bay, Cal. It is about 13 miles in length by 1 mile wide, with a tidal area of about 15 square miles, which includes about 1,000 acres of anchorage with a depth of not less than 18 feet at mean lower low water.

Existing project.—The existing project provides for securing such additional depth on the ocean bar as can be obtained and maintained by the construction and operation of a seagoing hydraulic dredge and for dredging the bay channels between the bar and the town of Marshfield, 13 miles, with a view to securing a depth of 18 feet at mean lower low water and width of 300 feet opposite the towns of North Bend and Marshfield and 200 feet at other points, at an estimated first cost of \$500,000 and \$60,000 annually for maintenance. The project was adopted by the river and harbor act of June 25, 1910. (See H. Doc. No. 958, 60th Cong., 1st sess.) The mean tidal variation is 4.8 feet at the entrance and 4.4 feet at the head of the bay.

Condition at the end of fiscal year.—Jetty construction was commenced in 1879 and completed in 1894. From 1894 to 1901 restoration of jetty enrockment was in progress. In 1909 the balance of the appropriation was applied to dredging the inner harbor. The foregoing work provided a north jetty 9,520 feet long, which resulted in increasing the depth to 20 feet across the bar and in dredging a channel 12 feet deep at mean low water to Marshfield. Since 1891 about 850 acres of the North Spit has been reclaimed by planting Holland grass thereon. Operations under the existing project include the dredging of an 18-foot channel from the bar entrance to Marshfield, completed September 15, 1912, at a cost of \$89,752.53; the construction of the dredge *Col. P. S. Michie*, at a cost of \$378,198.63; and the operation of the *Michie*, at a cost of \$166,466.64, of which the port of Coos Bay contributed \$3,800 for operation, and \$31,561.13 was for betterments and repairs. Since dredging operations began, May 10, 1914, the bar channel depth has been increased from a depth of 19 feet in a channel about 200 feet wide to a depth of 30 feet at mean lower low tide in a channel 400 feet wide.

At the close of the fiscal year 1916 the outer 1,500 feet of the jetty had subsided considerably and was entirely submerged at low water. From a point about 1,500 feet from the outer end of the jetty to low water shore line the crest of the jetty enrockment was about half-tide level. The original height of the enrockment was about 27 feet above low water at its outer end and well above high water at the shore end. No work was carried on in the bay channels during the

year as the project depth of 18 feet was obtained in 1912, and has since been deepened from Pigeon Point to Smith's mill to 25 feet by the port of Coos Bay. This depth has not been maintained and there is now a controlling depth over the shoalest parts of about 19 feet between the bar and Smith's mill, 13 miles from the bar. The total expenditures under the existing project to the end of the fiscal year were \$653,425.99, of which \$547,518.33 was for new work and \$94,807.66 for maintenance from United States funds, and \$11,100 for maintenance from funds contributed by local interests.

Local cooperation.—No conditions in regard to local cooperation have been imposed by law, but the river and harbor act of March 4, 1913, directed the Secretary of War to use any additional money that may be placed at his disposal by the port of Coos Bay or by any other organization or by individuals for the improvement of the inner harbor. With the exception of \$11,100 contributed to operate the dredges *Michie* and *Oregon* in 1914 when no Government funds were available, no funds have been placed at his disposal. The port of Coos Bay, however, raised \$600,000 by the sale of bonds for the purpose of dredging a channel 300 feet wide and 25 feet deep at mean lower low tide, from a point above Marshfield to deep water in the lower bay, a distance of 13 miles, with turning basins 500 feet wide opposite Marshfield and North Bend. This work was finished in April, 1915, and in addition certain contiguous sloughs have been deepened by dredging. Since the beginning of the improvement to the end of the fiscal year 1916 local interests, consisting of the port of Coos Bay, the town of Marshfield, and others have expended approximately \$593,682.14 on the improvement of channels within the bay.

Effect of improvement.—The improvement has increased the available channel depths and has resulted in a reduction of freight rates, as oceangoing steamers can now ascend to Bay City, 14 miles from the bar. Above this point there is about 50 miles of channel available for navigation by boats of light draft and for rafting and logging purposes on the various connecting inlets.

Proposed operations.—The available balance will be expended in maintaining and operating U. S. dredge *Michie* in continuing the improvement and maintenance of the entrance channel, and in the operation of U. S. dredge *Oregon* in the maintenance of the bay channels to the project depth to June 30, 1917, as estimated and outlined in last annual report. The inner channels are shoaling considerably and it is expected dredging will be necessary during the fiscal year 1917. The following estimate is submitted for the fiscal year ending June 30, 1918:

Operating dredge Col. P. S. <i>Michie</i> one year, double shift during favorable months.....	\$70,000
Operating the dredge <i>Oregon</i> about six weeks.....	6,000
Engineering and contingencies.....	4,000
Total	80,000

Commercial statistics.—The principal exports are lumber products, coal, fish, and dairy products; while the imports consist of agricultural implements, mill machinery, and miscellaneous merchandise.

Comparative statement.

Calendar year.	Short tons.	Valuation.
1913.....	473,376	\$8,462,577
1914.....	520,409	10,508,766
1915.....	448,447	7,507,564

Amount expended on all projects from March 3, 1879, to June 30, 1916:

New work.....	\$1,349,614.77
Maintenance (including \$11,100 contributed by the port of Coos Bay)	284,708.49
Total.....	1,634,323.26
Balance available for fiscal year ending June 30, 1917.....	96,576.44

Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement.....	70,000.00
For maintenance of improvement.....	10,000.00
Total.....	80,000.00

TILLAMOOK BAY AND BAR, OREG.

Location and description.—Tillamook Bay is an indentation of the Oregon coast, about 50 miles south of the mouth of Columbia River, and 595 miles north of San Francisco Bay, Cal. It is about 6 miles long and 3 miles wide and has a tidal area of about 13 square miles, the greater part of which at low tide presents a succession of sand and mud flats traversed by three principal channels, which, although of fair depth near the entrance, gradually shoal toward the head of the bay.

Existing project.—This is a modification of the project approved by a board of Engineers officers under date of December 10, 1910, for securing a depth of 20 feet on the bar at mean lower low water. It provides for the construction of a north jetty 7,500 feet long at the entrance to the bay and the dredging of a channel from a point opposite Kincheloe Point to Bay City, about $3\frac{1}{2}$ miles, 16 feet deep at mean lower low tide, 200 feet wide in the straight reaches, but increased at the entrance and at curves, local interests to cooperate to the extent of paying one-half the original cost, and also to create and maintain a depth of at least 9 feet at mean high tide between Bay City and Tillamook. The estimated cost was \$814,000. The estimated cost of maintaining the channel from the entrance to Bay City is \$5,000 annually. No provision was made for maintaining the jetty. The project (see H. Doc. No. 349, 62d Cong., 2d sess.) was adopted by the river and harbor act of July 25, 1912. The river and harbor act of July 27, 1916, modified the project by making an appropriation of \$5,000 for maintenance of the channel from Bay City to Tillamook City. The section under improvement is 12 miles long, including about $3\frac{1}{2}$ miles from Bay City to Tillamook City. The mean tidal variation at the entrance is 6.3 feet, which decreases to about 5 feet at Tillamook. For last published map, see Annual Report of Chief of Engineers for the year 1914, page 3192.

Condition at the end of fiscal year.—Operations commenced in 1890 with the construction of about 1,148 feet of pile dikes and 449 feet of pile and brush revetment, but this work was destroyed by the freshets of the following winter and spring. From 1892 to 1901 several dikes were constructed with a view to increasing the depth of water in Garibaldi Channel and Hoquarten Slough so as to aid vessels in reaching Tillamook City, and a channel was excavated from the north fork of Trask River to Hoquarten Slough, by means of which the waters of both forks of the river were emptied into the slough above Dry Stocking Bar; snags were removed from Hoquarten Slough Channel between Tillamook and Bay City; and shoals were dredged and deflecting dikes constructed in and along the selected channel leading from Hobsonville to Tillamook City, which resulted in making this channel 9 feet deep at mean high tide, as called for by the project. Under the existing project the construction of the north jetty was commenced the latter part of June, 1914 (under contract), and at the close of the fiscal year 1916 the jetty tramway had been constructed for a distance of 4,965 feet and was well enrocked for a distance of 2,250 feet and partially enrocked to the end of the tramway. There yet remains 1,035 feet of tramway to construct to carry enrockment to the project end of the jetty, a total distance of 6,000 feet. A total of 243,243 tons of stone has been placed in the enrockment. The jetty is 59 per cent complete. It is believed the jetty construction work will be finished by January, 1917. The 16-foot project channel from Bay City to deep water opposite Kincheloe Point, a distance of about 3 miles, is 70 per cent complete. The existing project is now about 60 per cent complete.

A survey of the channel between Tillamook and Bay City, made in June, 1916, shows a controlling depth of 4 feet at mean lower low water in a channel of 60 feet minimum width. A survey of the entrance, made June 24, 1916, shows a controlling depth of 16 feet at mean lower low water on the bar in a channel 300 feet wide, and 12 feet on the inner shoal, in a channel 300 feet wide, which is about 4,000 feet from the crest of the bar. The partial construction of the north jetty has fixed the channel across the bar. The bay channels have been maintained so that vessels drawing 9 feet can safely navigate the bay and Hoquarten Slough to Tillamook at ordinary high tide.

The total expenditures under the existing project are \$435,856.68, all for new work, of which \$223,831.16 was from United States funds, and \$212,025.52 contributed by local interests. In addition, the United States expended \$4,992.07 contributed funds in maintenance of the channel from Bay City to Tillamook.

Local cooperation.—The river and harbor act of July 25, 1912, which adopted the existing project, imposed the conditions that local interests shall cooperate to the extent of paying one-half the total estimated cost of the improvement (\$814,000) and shall create and maintain an effective channel 9 feet deep at mean high tide between Bay City and Tillamook. The necessary guaranties have been furnished and were approved by the Secretary of War August 4, 1913, and the United States has entered into contract for the construction of the north jetty in accordance with the project. At the close of the fiscal year 1916 the expenditure of funds contributed

by local interests, consisting of the ports of Bay City and Tillamook on the present project, amounted to \$218,608.20, of which \$213,616.13 was expended by the United States for jetty construction and \$4,992.07 for creating and maintaining the channel between Bay City and Tillamook. The sum of approximately \$16,917.91 was previously expended for maintaining the inner channels by dredging.

Effect of improvement.—The effect on freight rates has not been reported. The work of improvement has made transportation by water safer, easier, and better. Vessels drawing 9 feet have no difficulty at mean high tide in reaching Tillamook, 12 miles from the entrance.

Proposed operations.—The available funds will be exhausted for jetty construction, for dredging the 16-foot channel from Bay City to the entrance, and for maintenance by dredging, and it is believed that the funds now available will be sufficient to complete the project and that the work will be finished by January, 1917.

The following estimate for maintenance of channel from the entrance to Bay City during the fiscal year ending June 30, 1918, is submitted: Maintenance by dredging, one year, \$5,000.

If it is intended that local interests shall be relieved of the duty of maintaining the channel between Bay City and Tillamook, and that responsibility for that work shall be assumed by the United States, the further sum of \$8,000 should be appropriated for the dredging required in the fiscal year 1918 to maintain that part of the channel between Bay City and Tillamook.

Commercial statistics.—The principal exports are farm and dairy products. The imports are agricultural implements, machinery, and miscellaneous merchandise. The commerce for the calendar year 1915 amounted to 9,710 short tons, valued at \$1,371,000. The usual draft of vessels handling the commerce of the bay is about 9 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	9,185	\$1,035,500
1914.....	9,018	1,173,700
1915.....	9,710	1,371,000

CONSOLIDATED.

Amount expended on all projects from Aug. 11, 1888, to June 30, 1916:

New work.....	\$513,065.60
Maintenance	76,490.54
Total	589,556.14

Balance available for fiscal year ending June 30, 1917.....	85,237.44
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	5,000.00

COOS RIVER, OREG.

Location and description.—Coos River rises in two forks in the Coast Range in southern Oregon. flows about 60 miles in a general

westerly direction, and empties into Coos Bay nearly opposite Marshfield, Oreg.

Existing project.—The existing project provides for the removal of snags and bowlders (by dredging or otherwise) from a selected channel 50 feet wide from the mouth of the river to the head of navigation on both forks, $8\frac{1}{2}$ miles above their confluence, at an estimated cost of \$5,000, Government plant to be borrowed from Coos Bay at such times as it can be spared. This estimate was increased to \$8,000 in 1898, when the channel was found to be so thickly studded with snags that it was not possible to remove all of them with the funds available. It was then stated \$1,500 annually would be required for maintenance. The project was adopted by the river and harbor act of June 3, 1896. (See H. Doc. No. 237, 53d Cong., 3d sess.) The section under improvement includes the mouth and $5\frac{1}{2}$ miles of the main river and about $8\frac{1}{2}$ miles of each fork. For last published map see House Document No. 237, Fifty-third Congress, third session.

Condition at the end of fiscal year.—Snagging and removal of bowlders by hired labor and use of Government plant commenced in 1897, and the project was completed in 1899. This work provided a channel 50 feet wide with a depth on June 30, 1900, of 2 to 4 feet at mean lower low tide over the shoalest portion. Since the completion of the project only maintenance work has been done. The total expenditure under the existing project to the close of the fiscal year was \$24,950, of which \$8,000 was for new work and \$16,950 for maintenance. During August and September the river is at its lowest stage, and the ruling depth with a zero gauge from the mouth is about 4 feet in a channel 50 feet wide to the head of the tidal reach on the north fork and about $3\frac{1}{2}$ feet in a channel 50 feet wide to the head of the tidal reach on the south fork.

Effect of improvement.—There is no railroad serving the locality. The river furnishes the only means of transportation for the farmers to reach the markets, to whom the improvement has been of great benefit and is enabling them to materially increase shipments of products from accessible points along the river.

Proposed operations.—The channels of Coos River silt up every winter and snags are carried into them by the freshets. The funds available for the improvement were exhausted by June 30, 1916. The funds appropriated by the river and harbor act approved July 27, 1916, will be exhausted by June 30, 1917. The following estimate is submitted for the fiscal year 1918 to maintain the project:

Dredging with either hired plant or Government plant, $2\frac{1}{2}$ months, at \$1,000 per month	\$2, 500
Engineering and contingencies	500
Total	3, 000

Commercial statistics.—The exports consist principally of logs, lumber, and dairy products, while the imports are agricultural implements, mill machinery and supplies, and general merchandise. The total commerce during the calendar year 1915 amounted to 89,121.5 short tons, valued at \$2,485,573. About 80 per cent of the tonnage consists of logs, towed. The draft of the deepest boats on the river does not exceed 4 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	67,259.0	\$2,075,695
1914.....	103,084.0	2,280,600
1915.....	89,121.5	2,485,573

The decrease in the commerce of the river in 1915 is due to the depressed lumber market, which decreased the amount of logging on the stream.

Amount expended on all projects from June 3, 1896, to June 30, 1916:

New work	\$8,000.00
Maintenance	16,950.00

Total	24,950.00
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Balance available for fiscal year ending June 30, 1917.....	3,050.00
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	3,000.00
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MOUTH OF SIUSLAW RIVER, OREG.

Location.—Siuslaw River rises in the Coast Range, flows about 110 miles in a westerly direction, and empties into the Pacific Ocean through a low, shifting sand beach about 160 miles south of the mouth of Columbia River and 485 miles north of San Francisco Bay, Cal.

Existing project.—The present project provides for securing a bar channel depth of 8 feet at mean lower low tide by the construction of two mean high-tide rubblestone jetties, the north jetty to extend westerly from a point near the end of the old jetty, on a curve of 4,000 feet radius, along the edge of the north spit for a distance of 3,700 feet; the south jetty to extend westerly, on a curve of 2,350 feet radius, across the south spit for a distance of about 4,200 feet, the jetties being 750 feet apart at their extremities. The estimated cost was \$426,000, with \$5,000 annually for repairs and maintenance during construction. The present project (see H. Doc. No. 648, 61st Cong., 2d sess.) was adopted by the river and harbor act of June 25, 1910, which appropriated \$50,000, and authorized continuing contracts not exceeding \$165,000, exclusive of the amount appropriated, all of which has been appropriated.

The original estimate proved too small on account of the greater amount of enrockment required, due to the scour of the ocean bed in advance of the jetty, and on January 30, 1914, a revised estimate of \$225,000 for additional funds necessary to complete both jetties was submitted. Local interests agreed to furnish one-half of this amount. The Secretary of War allotted the sum of \$112,500 for this construction and \$5,000 additional for maintenance from funds appropriated by the river and harbor act of March 4, 1915, on condition that local interests should furnish \$112,500 toward the construction. The mean variation of tides at the entrance and within the harbor is 5.2 feet. The tidal influence extends to the foot of the rapids, about 19 miles from the ocean, where it is 3 feet. The section under improvement at

the entrance is about 1 mile long. For last published map of entrance see Annual Report for 1914, page 3188.

Condition at the end of fiscal year.—North jetty: Preliminary work was commenced in 1891 and in 1901 the jetty, including tramway approach, had been completed for a distance of 4,090 feet. This work resulted in somewhat checking the tendency of the bar channel to shift its position as far north as occurred before the improvement. Under the present project the extension of the north jetty was commenced under contract January 10, 1912, and was extended to a point 7,245 feet from the receiving wharf by October 31, 1914, when the contract was completed, available funds exhausted, and work suspended. Under contract dated August 5, 1915, work on the jetty was resumed, and at the end of the fiscal year the tramway had been extended to bent No. 522, the project end, a distance of 7,575 feet from the receiving wharf. During the fiscal year a total of 63,625 tons of stone was placed in the enrockment. It is estimated that 36,000 tons of stone will be required to complete the north jetty enrockment.

South jetty: Under permit dated July 23, 1908, from the Secretary of War, the port of Suislaw constructed 2,940 feet of tramway for this jetty and placed \$65,500 tons of stone therein by June 18, 1911, at a cost of \$89,509.11, when the work was taken over by the United States under the existing project. No further work was done on this jetty until the present year, when, under contract dated August 5, 1915, repairs to receiving wharf and tramway began, preparatory to enrockment. To complete the south jetty will require the repair of the existing tramway, the construction of about 960 feet of tramway extension to the project end, and the placing of about 100,000 tons of rock therein.

The entire project is about 80 per cent complete.

The total expenditures under the existing project were \$508,373.94, of which \$246,954.22 was for new work and \$15,000 for maintenance, from United States funds, and \$246,419.72 was for new work from funds contributed by the port of Suislaw, including \$100,000 credited for useful work performed.

The work has resulted in fixing the channel and has secured a depth of 12 feet at mean lower low water over the bar in a channel 150 feet wide, which is 6 feet greater than existed prior to improvement. Vessels drawing 12 feet can now safely cross the bar in ordinary high tide and ascend the river for a distance of 5 miles.

Local cooperation.—No conditions were imposed by law in connection with the original or modified project. On July 23, 1908, the port of Suislaw was granted permission to improve the mouth of the river by the construction of as much of the south jetty as could be done by the expenditure of \$100,000 in conformity with plans and report of Capt. W. C. Langfitt, Corps of Engineers, dated February 5, 1903. The river and harbor act of June 25, 1910, adopted the project on condition that half of the cost should be borne by local interests. This act was amended by the river and harbor act of February 27, 1911, which provided that the port might proceed with the construction of the south jetty to the full extent of the contract entered into by it December 24, 1909, the amount of one-half required to be furnished by the port or other agency to be reduced by such amount, not exceeding \$100,000, as may have been properly expended under the contract.

Under these conditions the port built 2,940 feet of tramway and placed 65,500 tons of rock in the jetty, at a cost of \$89,509.11. Operations were suspended June 18, 1911, on account of the exhaustion of funds. The port of Siuslaw furnished a bond to insure its contribution toward the cost of the work in August, 1911, and the work was taken over by the Government. The total contribution by the port of Siuslaw under their bond was \$215,000 (including the \$100,000 credited for useful work performed) for original work on the jetties. In 1914 it was estimated that \$225,000 additional would be required to complete the project, making the total estimated cost of original work \$651,000. From the funds appropriated by the river and harbor act of March 4, 1915, an allotment of \$112,500 was made on April 2, 1915, for the completion of the project, with the provision that the port contribute an equal amount. The port of Siuslaw furnished a bond for this sum and the allotment of \$112,500 became available June 7, 1915.

Effect of improvement.—The work accomplished has rendered transportation by water safer and less costly by permitting vessels of greater draft to enter the river. On account of the depressed lumber market and scarcity of vessels, there has been no apparent effect on freight rates.

Proposed operations.—It is proposed to complete the north jetty, which will require the placing of about 30,000 tons of stone in the enrockment, the extension of the south jetty tramway to its project end, and placing approximately 100,000 tons of stone in the enrockment, which will complete the project on the date set for the completion of the present contract. September 30, 1917. It is believed the funds on hand will provide for the completion of the project. An estimate of \$5,000 is submitted for maintenance during the fiscal year 1918.

Commercial statistics.—The exports consist principally of lumber and farm and dairy products, while the imports are agricultural implements, mill machinery, supplies, and general merchandise. The total commerce during the calendar year 1915 amounted to 6,757 short tons, valued at \$442,060.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	32,995	\$1,495,841
1914.....	37,209	1,255,627
1915.....	6,757	442,060

There are extensive forests of fir, hemlock, and spruce tributary to the port, with sawmills having a daily capacity of 150,000 feet b. m. of lumber. Salmon canning and dairying are next in importance after lumbering.

UNITED STATES FUNDS.

Amount expended on all projects from Sept. 19, 1890, to June 30, 1916:

New work	\$398,655.05
Maintenance	25,611.27
Total	424,266.32

Balance available for fiscal year ending June 30, 1917.....	30,824.85
Amount that can be profitably expended in fiscal year ending June 30, 1918. for maintenance of improvement.....	5,000.00

CONTRIBUTED FUNDS.

Amount expended on all projects from Sept. 19, 1890, to June 30, 1916:

New work-----	\$246, 419. 72
Maintenance-----	-----
July 1, 1916, balance available-----	21, 274. 16

Amount expended on all projects from Sept. 19, 1890, to June 30, 1916:

New work (including \$100,000 credited port of Siuslaw for useful work performed)-----	645, 074. 77
Maintenance-----	25, 611. 27
Total-----	670, 689. 04
Balance available for fiscal year ending June 30, 1917-----	52, 099. 01
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	5, 000. 00

YAQUINA RIVER, OREG.

Location and description.—Yaquina River rises in the Coast Range, flows about 30 miles in a westerly direction, and empties into Yaquina Bay, a harbor on the Oregon coast about 115 miles south of the mouth of Columbia River and 540 miles north of San Francisco Bay, Cal.

Existing project.—The existing project provides for the construction of two controlling half-tide brush dikes, the purchase of dredging plant, and excavating a channel through various shoals from a point just below the Fir & Spruce Lumber Co.'s dock in Depot Slough, at Toledo, to deep water above Oysterville, about 6 miles; the channel to be 10 feet deep at mean lower low water and 150 feet wide in straight reaches and 200 feet wide on the curves, at an estimated cost of \$72,000, and \$3,000 every two years for maintenance. The project was adopted by the river and harbor act of March 4, 1913. (See H. Doc. No. 519, 62d Cong., 2d sess.) The mean tidal variation at the mouth of the river is 6.2 feet and decreases to about 3 feet at Elk City, 18 miles from the mouth. For last published map, see House Document No. 519, Sixty-second Congress, second session.

Condition at the end of fiscal year.—The project was completed December 31, 1914. There is now a channel 10 feet deep at mean lower low water from the entrance to the bay to Toledo, with a minimum width of 150 feet. At ordinary high water, when the channel is used by ocean shipping, vessels drawing as much as 14 feet can safely reach Toledo. With a 5-foot gauge reading, a 6-foot draft can be carried to Elk City, 18 miles from the mouth, throughout the year. The total amount expended to the end of the fiscal year was \$74,789.31, of which \$28,849.27 was for new work and \$2,740.04 for maintenance from United States funds, and \$43,200 for new work contributed by local interests.

Local cooperation.—The project was adopted under condition that local interests contribute 60 per cent of the first cost, either in cash or useful work performed prior to actual construction work by the United States, and that the floating plant belonging to the port of Toledo remain available for use by the United States on work of construction and maintenance without cost to the United States other than for upkeep while in use. This condition has been fulfilled to

date. Previous to the adoption of the project the citizens organized themselves into a port district under the State law, and in 1911 realized \$50,000 by the sale of bonds. With these funds the improvement of the river from the bar to Toledo was commenced under permit from the Secretary of War dated August 6, 1910. The port constructed two dikes, built a bucket dredge, and excavated a narrow channel 9 feet deep at low tide from a point in Depot Slough to a point just below Altree's mill, a distance of 3,300 feet, at a total cost of \$37,430.57. This work, which has been accepted, is in accord with the project, and \$5,769.43 turned over to the United States constitutes the 60 per cent required by the act.

Effect of improvement.—The work accomplished has resulted in increased water-borne commerce, and in Toledo being granted common-point rates by the railroad, as ocean-going vessels drawing as much as 14 feet can now ascend to Toledo, $9\frac{1}{2}$ miles from the mouth.

Proposed operations.—The available funds for maintenance are now practically exhausted and an estimate of \$3,000 is submitted for maintaining the channel during the fiscal year 1918.

Commercial statistics.—The principal exports are lumber, farm and dairy products, live stock, and salmon. The imports consist of agricultural implements, mill machinery, and miscellaneous merchandise. The total commerce for the calendar year 1915 amounted to 8,452 short tons, valued at \$88,256. The maximum draft of sea-going vessels which carry lumber is about 14 feet.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	14,860	\$876,708
1914.....	18,241	548,600
1915.....	8,452	88,256

Amount expended on all projects from March 4, 1913, to June 30, 1916:

New work (including \$43,200 contributed by local interests)---	\$72,049.27
Maintenance -----	2,740.04

Total -----	74,789.31
-------------	-----------

July 1, 1916, balance available-----	249.96
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement-----	3,000.00

SNAKE RIVER, OREG., WASH., AND IDAHO.

Location and description.—Snake River is the largest tributary of Columbia River, and rises in Yellowstone National Park, in the western part of Wyoming, flows in a general westerly direction for about 1,000 miles, and empties into Columbia River near Pasco, Wash., 324 miles from the Pacific Ocean.

Existing project.—The project provides for completing and maintaining the improvement between Lewiston, Idaho, and Riparia, Wash., with a view to obtaining an extreme low-water channel generally 60 feet wide and 5 feet deep by blasting, dredging, raking gravel bars, and by construction of some contraction works, and for

general improvement by the same methods from the mouth to Pittsburgh Landing. The section included in the project is 216 miles long. The estimated cost of improvement is \$236,690, apportioned as follows: \$165,000 from the mouth to Riparia, Wash.; \$23,000 from Riparia to Lewiston, Idaho; and \$48,690 from Lewiston to Pittsburgh Landing, Idaho. The estimated cost of maintenance is \$5,000 per year. The project is based on estimates and surveys which have been printed. (See H. Doc. No. 411, 55th Cong., 2d sess.; H. Doc. No. 127, 56th Cong., 2d sess.; and Annual Reports for 1903 and 1906.) It was adopted by the river and harbor act of June 13, 1902. For the last published map see Annual Report Chief of Engineers, 1906, page 1988.

Condition at the end of fiscal year.—The improvement work has consisted of widening and deepening existing channels by open-river methods. No greatly increased depths have been obtained, but the work done has made navigation much safer than formerly, and the length of the navigation season has been somewhat increased. On account of the narrow channels and swift water through the rock reefs below Riparia, navigation has been limited to stages above 3 feet on the Lewiston gauge when a draft of 4 feet can be carried. This gives a navigation season of about 150 days during the spring months (March to July, inclusive), and occasionally a second navigation season of 3-foot stage occurs in November and December, due to fall rains. Only one steamboat line has operated on Snake River below Riparia, and has operated only under favorable conditions of river. With smaller lighter draft boats it would be possible to navigate the river below Riparia for about nine months of the year, as it has always a stage greater than 1 foot for eight and one-half months of the year. From Riparia to Lewiston a draft of 4 feet can be carried throughout the year at a 1-foot stage. The existing project contemplates a depth of 5 feet from the mouth to Lewiston, Idaho, which it is believed can not be obtained by open-river methods, especially below Riparia. The project is about 77 per cent complete. The total expenditure by the United States under the existing project to the end of the fiscal year, including \$85,000 contributed by the State of Washington, was \$307,643.75, of which \$196,162.37 was for original work and \$111,481.38 for maintenance.

Local cooperation.—No conditions regarding local cooperation were imposed by law. The Washington State Legislature, however, in 1907 appropriated \$100,000 for expenditure by the Federal Government between Riparia, Wash., and the mouth, but of this sum only \$85,000 was used. The final requisition for \$15,000 was not honored by the State auditor because the time for expenditure had lapsed prior to the last requisition. This appropriation by the State was made as the result of a general disposition to revive river navigation and utilize the State Portage Railroad, which was built by the State of Oregon in 1905, around the obstructions in the Columbia River between Celilo and Big Eddy, Oreg. The expenditure of \$85,000 was made for general open-river work in accordance with the adopted project.

Effect of improvement.—The work done has resulted in an increased channel depth and width through the most difficult shoals and reefs, making navigation much easier and safer. A substantial reduction of freight rates has been made since the beginning of opera-

tions, due in part to the improved channels in the Snake and the improvement of Columbia River at the Cascades and Celilo Falls, permitting through river transportation from Portland to Lewiston.

Proposed operations.—It is proposed to operate the U. S. S. *Asotin* and *Umatilla* and two drill scows in removing rocks and reefs, constructing wing dams, and raking existing channels through shoals between the mouth of the river and Riparia; and the steamer *Asotin* in similar work above Riparia. Work was suspended in March, 1916, on account of lack of sufficient funds, and was not resumed until additional funds were available. The river and harbor act of July 27, 1916, appropriated sufficient funds to carry on the work estimated for and outlined in the last annual report, and these funds will be exhausted by June 30, 1917. To carry on the work during the fiscal year 1918 the following estimate is submitted:

Operation of steamers <i>Asotin</i> and <i>Umatilla</i>	\$13, 000
Operation of two drill scows.....	9, 000
Engineering and contingencies.....	3, 000
Total	25, 000

Of this sum \$20,000 is to be expended for improvement of existing channels by the usual methods, and \$5,000 for maintenance, all by Government plant operated by hired labor.

Commercial statistics.—The commerce during the calendar year 1915 amounted to 41,817.9 short tons, consisting of grain, general merchandise, wool, etc., valued at approximately \$1,347,937. Since the opening of The Dalles-Celilo Canal, May 5, 1915, there has been through steamer service between Portland, Oreg., and Lewiston, Idaho. From May 5 to July 23, 1915 (the close of the navigation season), 1,400 tons of through freight passed over the section of river under improvement. On account of the short navigation season on the river below Riparia, March 15 to July 15, the bulk of the commerce is carried on the river between Riparia and Lewiston, where navigation is possible throughout the year.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	46,877	\$1,301,830
1914.....	32,137	1,085,677
1915.....	41,817	1,347,937

Amount expended on all projects from 1902 to June 30, 1916:

New work (including \$85,000 contributed by State of Washington).....	\$349, 572. 63
Maintenance.....	126, 571. 12
Total.....	476, 143. 75

Balance available for fiscal year ending June 30, 1917.....	25, 464. 95
Amount (estimated) required to be appropriated for completion of existing project.....	125, 062. 68

Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement.....	20, 000. 00
For maintenance of improvement.....	5, 000. 00

Total	25, 000. 00
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COLUMBIA RIVER AND TRIBUTARIES ABOVE CELILO FALLS TO THE MOUTH
OF SNAKE RIVER, OREG. AND WASH.

Location and description.—Columbia River rises in the southeastern part of British Columbia, flows in a northwesterly direction for about 175 miles, thence in a general southerly direction for about 250 miles until it reaches the international boundary, thence in a general southerly and westerly direction for about 424 miles to its confluence with the Snake River, thence in a general westerly direction for 324 miles between the States of Oregon and Washington, until it empties into the Pacific Ocean. It has a total length of 1,200 miles.

Existing project.—This project provides for removing obstructing boulders and ledges and raking the gravel shoals in order to provide safe navigation of such channels as now exist, the work to be done by operation of Government plant. The section included in the project is 124 miles long. The lower end of the project is about 200 miles from the mouth of the river. The total estimate is \$400,000, to be expended during a series of years. This estimate also includes the cost of a suitable plant, at about \$60,000, and \$30,000 annually for operation of the plant in work of maintenance. The project is based on a survey authorized by river and harbor act of March 3, 1905, and was adopted by the river and harbor act of March 2, 1907. (H. Doc. No. 440, 59th Cong., 2d sess.) For last published map see Annual Report for 1906, page 1988.

Condition at end of fiscal year.—The work done consisted of blasting submerged reefs and boulders and scraping gravel bars, using Government plant operated by hired labor. The work accomplished has resulted in improving the channel through the troublesome shoals and providing a least depth of $4\frac{1}{2}$ feet at extreme low water. This minimum depth exists at Homly Rapids only, the channel having generally a least depth of 6 feet through the shoals, with improved channels through the rock reefs. Steamboats can carry a draft of 4 feet at a zero stage of river, which rarely occurs, and then only during freezing weather. Normal low-water stage is 1 foot on Umatilla gauge. The maximum draft of the steamers operating on the river above Celilo does not exceed $4\frac{1}{2}$ feet, so that navigation is possible at all stages of river. No specific channel width or depth is given in the project, but based on the estimate of the work outlined the project is 88 per cent complete. The total amount expended under the existing project was \$413,238.27, of which \$373,238.27 United States funds and \$25,000 contributed by the State of Washington was for new work and \$15,000 for maintenance.

Local cooperation.—No conditions regarding local cooperation were imposed by law, but the State of Washington in 1907 appropriated \$25,000 for expenditure by the Federal Government on this improvement. The money was expended in the construction of a drill scow and in removing rock ledges and raking gravel bars at Umatilla and Homly Rapids by using Government plant.

Effect of improvement.—The work done has rendered navigation much easier and safer and has increased the length of the low-water navigation season. A substantial reduction of freight rates has been made since the beginning of operations, and it is reported that a reduction of 14 per cent in rail rates was made upon the completion of the Oregon State Portage Railway from Big Eddy to the head

of Celilo Falls in 1905, which permitted through transportation of river freight. Since the opening of The Dalles-Celilo Canal, May 5, 1915, there has been some further reduction of rail rates to river points.

Proposed operations.—It is proposed to continue improvement of existing channels through the principal shoals and rapids, using Government plant operated by hired labor. Work was suspended in March, 1916, on account of lack of funds, and could not be resumed until additional funds were made available. The river and harbor act of July 27, 1916, appropriated sufficient funds to carry on the work estimated for and as outlined in the last annual report, and these funds will be exhausted by June 30, 1917. To carry on the work until June 30, 1918, the following estimate is submitted:

Operating steamers <i>Umatilla</i> and <i>Asotin</i>	\$24, 000
Operating three drill scows.....	16, 000
Engineering and contingencies.....	5, 000
Total	45, 000

The *Asotin* and two drill scows will be used on Snake River when the river stage is favorable. Of the above amount, it is proposed to expend \$15,000 for the improvement and \$30,000 for maintenance.

Commercial statistics.—The amount of tonnage passing through the canal from May 5 to December 31, 1915, is 8,394 short tons, valued at approximately \$809,088, indicating the probable increase of traffic for the river above Celilo, Oreg.

Amount expended on all projects from June 10, 1872, to June 30, 1916:

New work (including \$25,000 contributed by State of Washington)	\$518, 238. 27
Maintenance	15, 000. 00
Total	533, 238. 27
Balance available for fiscal year ending June 30, 1917.....	41, 385. 78
Amount (estimated) required to be appropriated for completion of existing project.....	15, 000. 00

Amount that can be profitably expended in fiscal year ending June 30, 1918:

For works of improvement.....	15, 000. 00
For maintenance of improvement.....	30, 000. 00
Total	45, 000. 00

WILLAMETTE RIVER ABOVE PORTLAND AND YAMHILL RIVER, OREG.

Location and description.—The Willamette River rises in the Cascade Range in southwestern Oregon, flows northerly, and empties into the Columbia River about 100 miles from the sea. Its length from the source of the middle fork is about 294 miles.

Existing project.—The existing project (H. Doc. No. 260, 54th Cong., 1st sess., and Annual Report for 1896, p. 3309) was adopted by the river and harbor act of June 3, 1896. This project was modified in 1904, and again by the river and harbor act of July 25, 1912.

The modified project therefore for the construction of a lock and dam in the Yamhill River for snagging and the removal of obstructions in the Yamhill River between McMinnville and the mouth; for snagging between Harrisburg and Corvallis, to facilitate high-water

navigation; for dredging, snagging, and dam and revetment work to obtain a low water depth of 2½ to 3½ feet between Corvallis and Oregon City; and for securing by dredging and the removal of Copeleys Rock a channel 6 feet deep at low water between Oregon City and Portland, 100 feet wide above the foot of Clackamas Rapids and 150 to 200 feet wide below. The stretches included in the project are for the Yamhill River from McMinnville to the mouth (18 miles) and for the Willamette River from Harrisburg to Portland (152 miles), 12 miles above the mouth.

Locks and dams on Willamette and Yamhill Rivers.

	Willamette River.	Yamhill River.
Location.....	At Willamette Falls, near Oregon City, Oreg., 25 miles above the mouth.	Near La Fayette, Oreg., 8 miles above the mouth.
Dimensions.....	Flight of 4 locks, each 210 by 40 feet...	210 by 40 feet.
Lift.....	10½ feet each; total, 41 feet.....	16 feet.
Available depth at low water.	2 feet.....	3 feet.
Foundation.....	Rock.....	Timber piles.
Kind of dam.....	Fixed.....	Fixed.
Type of construction.....	Concrete.....	Timber crib.
Date of completion.....	1873 (purchased Apr. 26, 1915).....	Sept. 21, 1900.
Cost.....	Unknown (purchase price, \$375,000)...	\$72,164.83.

Condition at the end of fiscal year.—The lock and dam in the Yamhill River were completed September 21, 1900, at a total actual cost of \$72,164.83. Snagging has been carried on between Harrisburg and Corvallis on the Willamette River, snagging and dredging between McMinnville and the mouth on the Yamhill River, and snagging, dredging, and the construction of auxiliary training works between Corvallis and Oregon City on the Willamette River. The controlling depths at low water at the end of the year were 2 feet between Oregon City and Salem on the Willamette River (59 miles) and from the mouth to McMinnville on the Yamhill River, and 2½ feet between Salem and Independence on the Willamette River (11 miles). Between Independence and Corvallis (36 miles) traffic is carried on only at higher stages of water. The project channel between Oregon City and Portland was obtained in 1914 by dredging and the removal of Copeleys Rock, and has since been maintained. Loaded boats plying between Portland and Oregon City draw from 2 to 5 feet; from Oregon City to Corvallis about 2 feet all the year around. The project is about 75 per cent complete. Bank revetments at Albany and Salem remain to be constructed when conditions require. The total amount expended on the present project to the end of the fiscal year was \$632,233.92, of which \$250,938.80 was for new work and \$381,295.12 for maintenance.

Effect of improvement.—The improvement has rendered possible regular light-draft steamboat traffic between Portland and Corvallis on the Willamette River and between the mouth and Dayton on the Yamhill River during the entire year; also between Corvallis and Harrisburg on the Willamette River and between Dayton and McMinnville on the Yamhill River for about nine months of the year. This has resulted in controlling railroad freight rates. At points where rail and water transportation meet the rates are practically the same; for points where there is no water transportation the rail

rates are greater than the mileage would indicate. Thus on first-class freight from Portland to Corvallis (97 miles by rail and 119 miles by water) the rail rate per hundred is 28 cents and the water rate 25 cents. Between Portland and Eugene, where there is no water competition, the rail rate is 46 cents per hundred; the rail distance is 124 miles.

Proposed operations.—The funds available will be exhausted about June 30, 1917, and will be expended as follows:

Maintenance:

Operation of dredge <i>Mathloma</i> , 12 months, at \$1,500-----	\$18, 000
Operation of dredge <i>Champocg</i> , 4 months, at \$1,200-----	4, 800
Construction of and repairs to floating plant-----	13, 000
Construction of training dikes-----	8, 000
Repairs to training dikes, dams, etc-----	3, 000
Engineering and contingencies-----	5, 200
Total-----	52, 000

The funds for which estimate is submitted are for maintenance for the period July 1, 1917, to June 30, 1918, as follows:

Operation of dredges <i>Mathloma</i> and <i>Champocg</i> , 12 months-----	\$21, 000
Repairs to training dikes, dams, etc-----	5, 000
Construction of and repairs to training dikes-----	7, 000
Engineering and contingencies-----	3, 300
Total-----	36, 300

The estimate is larger than the average expended for maintenance for the last three years on account of shortage of funds in 1916. The full amount of the estimate is required to properly maintain the channel.

Commercial statistics.—The commerce during the calendar year 1915 was principally flour, grain, mill feed, logs, lumber, fuel oil, paper and pulp, sand, gravel, farm products, furniture and household goods, building material, and general merchandise.

Comparative statement.

Calendar year.	Short tons.	Estimated value.
1913.....	764, 862	\$8, 534, 689
1914.....	516, 552	8, 978, 320
1915.....	560, 560	8, 828, 079

All of the commerce is affected by the improvement. About one-half of the tonnage consists of sand, gravel, and oil, which is handled in scows, the usual limit of draft being 5 feet.

Amount expended on all projects from Mar. 3, 1871, to June 30, 1916:

New work-----	\$498, 686. 31
Maintenance-----	381, 295. 12
Total-----	879, 981. 43

Balance available for fiscal year ending June 30, 1917-----	52, 036. 79
Amount (estimated) required to be appropriated for completion of existing project-----	52, 300. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement and for maintenance-----	36, 300. 00

FALLS OF THE WILLAMETTE RIVER, AT OREGON CITY, OREG.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1060, Sixty-second Congress, third session:

The falls of Willamette River at Oregon City are 12 miles above Portland and are formed by a rocky reef across the river. The vertical distance between water level above and below the falls is about 41 feet at ordinary low water, to overcome which a canal and four locks, each 210 feet long, 40 feet wide, and having a lift of about 10 feet, were constructed by private enterprise on the west side of the falls during 1870–1872. The total length of the canal, including the flight of locks and entrance at its lower end and the canal basin which is 1,250 feet long, together with a guard lock 210 feet long at its upper end and the upper entrance 1,000 feet long, is about 3,500 feet. A fixed concrete dam has also been constructed along the crest of the falls and the level of the water raised $1\frac{1}{2}$ feet for power purposes.

As a result of his investigations under the survey, the district officer recommended the construction of an entirely new canal on the opposite side of the river from the old canal as the most economical plan of improvement, as the owners of the existing canal held their property for the sum of \$600,000, which was considered excessive.

Under authority of a provision in the river and harbor act approved June 25, 1910, the district officer entered into negotiations for rights of way for the proposed new canal; but so many legal complications and obstacles developed, threatening an indefinite postponement of the work of improvement, that the district officer, with the consent of the department, again took under consideration the question of locating the improvement on the west side of the river and the consequent acquisition of the existing canal.

As a result of his further investigations, the district officer reported that if the owners would agree to accept the sum of \$375,000 for their locks, canal, and lands, the United States to construct sections A, B, C, and F of the division walls between canal and headrace, there would be a probable saving to the United States of \$75,000 over the probable award under condemnation proceedings if the property were acquired in that way, in addition to a saving of the expense incident to such proceedings and the indirect saving to the community in the earlier removal of tolls, and the probable reduction of freight rates. Should this offer be accepted by the company, he recommended improvement under the plan which he designated as No. 1 in his report of April 24, 1911, which contemplates, after acquisition of the property, the repairing and deepening of the old locks to a minimum depth of 6 feet at low water over the sills, widening and deepening the upper basin to a similar depth, rebuilding gates, and constructing division walls to separate the upper basin of the canal from the headrace which now runs directly from the basin, all at the estimated cost of \$300,000, making the total cost of acquisition and remodeling of the existing canal and locks under plan No. 1, \$675,000.

This offer has been made to the company and formally accepted by it, and the necessary transfer papers are now in course of preparation and arrangements have been conducted for the deposit of the available portion (\$200,000) of the funds to be contributed by the State of Oregon in a depository satisfactory to the Secretary of War. The balance of \$100,000 of the State contribution will not be available until January, 1913.

Of the United States appropriation of \$300,000 made by the above-quoted provision of the river and harbor act of June 25, 1910, the sum of \$5,000 has been expended in making necessary preliminary surveys, etc., leaving an available balance of that appropriation of \$295,000. With the funds contributed by the State, the total amount which will be available for this improvement will be \$595,000, or \$80,000 less than the estimated cost of acquiring and completing the work of remodeling the existing canal under plan No. 1, recommended by the district officer.

After due consideration of the above-mentioned reports, I concur in general with the views of the district officer and the Board of Engineers for Rivers and Harbors, and therefore, in carrying out the instructions of Congress, I report as follows: That the improvement by the United States of Willamette River at Oregon City, Oreg., is deemed advisable by the acquisition and rehabilitation as contemplated by plan No. 1, of the existing canal and locks at this locality, following in general the methods described in the report of the district officer at an estimated cost of \$675,000, for first construction. The

funds practically available for this improvement amount to \$595,000, and I recommend the appropriation of the balance of \$80,000, necessary to complete this work.

COLUMBIA AND LOWER WILLAMETTE RIVERS BELOW PORTLAND, OREG.

Location and description.—The Columbia River rises in British Columbia, flows southwesterly about 1,200 miles through Washington and between Oregon and Washington, and empties into the Pacific Ocean 610 miles north of San Francisco Harbor and 160 miles south of the Straits of Juan de Fuca.

Existing project.—The existing project provides for a channel 300 feet wide and 30 feet deep at low water from Portland to Brookfield, the head of the estuary (86 miles), and not less than 300 feet wide and 26 feet deep at mean lower low water, thence to the mouth of the river (27 miles), with an auxiliary channel 8 feet deep and 300 feet wide on the west side of Swan Island, in the Willamette River; estimated cost, \$3,770,000, with \$350,000 annually for maintenance. This project was adopted by the river and harbor act of July 25, 1912. (H. Doc. No. 1278, 61st Cong., 3d sess.) Cooperation offered by the port of Portland and accepted by the Secretary of War June 29, 1915, was estimated to make the first cost of the work to the United States not to exceed \$3,000,000 and the cost of maintenance by the United States not to exceed \$300,000 annually. The work is to be accomplished partly by the construction of stone and pile dikes and revetments, but chiefly by dredging, except where dredging is found to be ineffective. The river and harbor act of February 27, 1911, contained an appropriation and a continuing-contract authorization for the construction of two suitable dredging plants. Expenditures under this authorization have been considered as expenditures on the existing project. The stretches included in the project are 14 miles of the Willamette River from its mouth to the foot of Ross Island and 99 miles of the Columbia River from its mouth to the mouth of the Willamette River. Tidal variations range from about 2 feet at low-water stages at Portland to 7½ feet at the mouth of the Columbia River. For latest published map see opposite page 2606 of Annual Report for 1911.

By the river and harbor act approved July 27, 1916, the improvement of Columbia River between Vancouver and the mouth of Willamette River was combined with the project for improving Columbia and lower Willamette Rivers below Portland, Oreg., and the former improvement as a separate work in the first Portland district will be omitted from future annual reports and be consolidated with the latter improvement under supervision of the second Portland district.

Condition at the end of fiscal year.—The dredging plant was completed during the fiscal year 1914. A dike at Martin Island Bar was completed during the year and is in excellent condition. The project depth in the estuary was obtained during the fiscal year 1915 and has since been maintained. The project depth on all bars in the Columbia River above the estuary (except St. Helens Bar) has been obtained at various times, but on account of excessive shoaling during the annual freshets it has been impossible to maintain this depth on all bars. The latest surveys show the project depth on nine bars, the governing depth on the other five bars varying from 29½ to 26½, except at upper Martin Island Bar, where there is a small 25-foot lump. The governing depth in the Willamette River at low

water is 25 feet. A draft of 28 feet is practicable from February to September, and 25 feet for the balance of the year. At the end of the year about 99 per cent of the dredging had been done, the project being about 64 per cent completed. The work remaining to be done consists in a small amount of dredging and the construction of dikes and revetment where dredging is found to be ineffective. The total amount expended on the existing project to the end of the fiscal year was \$1,218,460.78, in addition to \$16,819.82 contributed by the port of Portland. Of this amount, \$864,501.44 was for new work and \$370,779.16 for maintenance.

Local cooperation.—The adoption by Congress of the present project in the river and harbor act of July 25, 1912, was conditioned upon the following-described cooperation by the port of Portland:

That the port of Portland shall assist in the work of improving and maintaining the channel in the Columbia River and shall be solely responsible for obtaining and maintaining the project channel in the Willamette River, not including the west channel at Swan Island. (Approved by the Secretary of War June 29, 1915.)

This cooperation is being carried out by the port of Portland, which has at present four pipe-line dredges to assist when needed in maintaining the channel in the Columbia and to take care of all work in the Willamette River. Under previous and existing projects up to December 31, 1915, about 33,295,000 cubic yards of material had been removed from various bars by the port of Portland dredges, at an approximate cost of \$1,462,100, and about \$368,000 has been expended by the port in the construction of dikes for the improvement of the channel.

There are two wharves and one small landing at Portland built with city funds. Municipal Dock No. 1, on the west side of the river, has a frontage of 955 feet and a slip 486 feet long by 120 feet wide. Municipal Dock No. 2, on the east side of the river, has a frontage of 526 feet. Ample trackage and warehouse space and a low-water depth of 30 feet have been provided at both. These wharves are modern in every way and cost about \$2,500,000. At St. Johns, about 6 miles below Portland, is a public wharf with 500 feet frontage, which cost about \$60,000. At Astoria, Oreg., there is a large municipal wharf, frontage 1,850 feet, including two slips about 1,200 feet long, which cost about \$1,000,000.

Effect of improvement.—The improvement of the Columbia and lower Willamette Rivers antedates the construction of the railroad between Portland and Astoria, so that no reduction in freight rates for this section of railroad can be shown. The effects of improvement are a saving in freights that would have to be paid if the same commerce were handled by rail between Portland and Astoria and vice versa instead of by deep-draft vessels. The savings on all commodities can not be estimated accurately, but may be taken for fuel oil, cement, and miscellaneous off-shore cargo, in which the saving is most clearly shown. For these items the Portland Chamber of Commerce presents the following figures as an annual saving in normal times:

Fuel oil, 982,000 tons, saving 85 cents per ton-----	\$834, 700
Cement, 122,499 tons, saving 50 cents per ton-----	61, 249
Miscellaneous, 37,668 tons, saving \$4 per ton-----	150, 672
Total per annum for these items-----	1, 046, 621

In addition to this amount there are undoubtedly large savings in the shipment of wheat, barley, lumber, etc., which are exported in large quantities from this district. Doubtless the admitting of deep-draft vessels 100 miles inland to Portland has had an indirect effect on rail rates from the interior to Puget Sound.

The improvement has greatly increased the draft of vessels that can ascend to Portland and has enabled steamship lines to operate on regular schedules.

Proposed operations.—It is proposed to expend the funds available as follows:

New work:

Construction of dikes.....	\$90,000	
Engineering and contingencies.....	10,000	
		<hr/> \$100,000

Maintenance:

Operation, two pipe-line dredges, 12 months, at \$7,500 each.....	180,000	
Operation of tug <i>Mendell</i> and surveys, 12 months, at \$1,500.....	18,000	
Work at United States moorings, 12 months, at \$1,000..	12,000	
Operation of dredge <i>Clatsop</i> , 12 months, at \$8,000.....	96,000	
Operation of dredge <i>Chinook</i> , 3 months, at \$15,000.....	45,000	
Repairs to existing dikes, etc.....	15,000	
Engineering and contingencies.....	37,000	
		<hr/> 403,000
Total		<hr/> 503,000

This will provide for maintenance to June 30, 1917, and for dike work to June 30, 1918. The funds for which estimate is submitted are for maintenance for the fiscal year ending June 30, 1918, as follows:

Maintenance:

Operation, two pipe-line dredges, 12 months, at \$7,500 each.....	\$180,000	
Operation of tug <i>Mendell</i> and surveys, 12 months, at \$1,500.....	18,000	
Work at United States moorings, 12 months, at \$1,000.....	12,000	
Operation of dredge <i>Clatsop</i> , 7 months, at \$8,000.....	56,000	
Repairs to existing dikes, etc.....	15,000	
Engineering and contingencies.....	29,000	
		<hr/> 310,000
Total		<hr/> 310,000

The estimate for maintenance is larger than the average expended for maintenance for the last three years, as dredging for improvement is practically completed, and hereafter all dredging will be charged to maintenance.

Commercial statistics.—Foreign exports during 1915 were mainly barley, flour, lumber, oats, and wheat; foreign imports, principally bags and burlap, fiber, rice, seeds, and sulphur. The domestic commerce consisted mainly of asphaltum, cement, dairy products, flour, iron and steel, logs, lumber, merchandise, mill feed, oil for fuel, paper, sugar, and wheat. The commerce handled by light-draft river vessels consisted of fish, grains, lime, plaster and cement, logs, lumber, mill feed, oil for fuel, paper, piling, pulp, sand and gravel, stone, wood, and general miscellaneous.

Comparative statement.

Calendar year.	Short tons.	Estimated value.
1913.....	7,923,902	\$102,058,764
1914.....	8,043,263	100,018,293
1915.....	7,208,455	112,950,103

All of the commerce affected used the improvement. The usual limits of loaded draft are 28 feet for foreign-bound steam vessels, 24 feet for foreign-bound sailing vessels, 27 feet for coastwise steamers, and 7 feet for local river steamers. Of 2,543,521 tons of freight carried by seagoing vessels, 7 per cent was carried in steamers to and from foreign ports, 17 per cent in sailing vessels to and from foreign ports, and 76 per cent in coastwise steamers. The balance, 4,664,934 tons, was handled by river vessels.

Amount expended on all projects from May 21, 1877, to June 30,

1916:

New work.....\$2,313,152.89

Maintenance.....1,561,734.68

Total.....3,874,887.57

Balance available for fiscal year ending June 30, 1917.....503,253.29

Amount (estimated) required to be appropriated for completion of existing project.....2,020,000.00

Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement and for maintenance.....310,000.00

COLUMBIA RIVER AT CATHLAMET, WASH.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 120, Sixty-third Congress, first session:

After due consideration of the reports I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore in carrying out the instructions of Congress I report as follows: That the improvement by the United States of Columbia River at Cathlamet, Wash., is deemed advisable so far as to remove snags and to secure an available channel depth of 10 feet at low water and a width of about 300 feet, increased at entrances and on curves, on the northerly side of the shoal to the westward of Cathlamet, following in general the methods described in the report of the district officer, at an estimated cost of \$6,000 for first construction and \$1,000 annually for maintenance, provided, however, that no expenditure shall be made for maintenance after a period of three years unless the Chief of Engineers and the Secretary of War shall be satisfied that the cost of continuing the work will be justified by resulting benefits to commerce. It is recommended that no special appropriation be made for this work, but that authority be given to incorporate it in the general project for the improvement of the Columbia and lower Willamette Rivers below Portland.

COLUMBIA RIVER AT THE MOUTH, OREG. AND WASH.

Location and description.—The mouth of the Columbia River is 610 miles north of San Francisco Harbor and 160 miles south of the Straits of Juan de Fuca.

Existing project.—The existing project provides for obtaining a channel across the bar 40 feet deep at mean lower low water and of

practicable width by extending the south jetty as completed in 1895 a farther distance of about $2\frac{1}{2}$ miles, constructing on the north side of the entrance a jetty about $2\frac{1}{2}$ miles in length, terminating 2 miles north of the end of the south jetty extension, and dredging. This project (H. Doc. No. 94, 56th Cong., 1st sess., and Annual Report for 1903, p. 2275) was adopted by the river and harbor act of March 3, 1905. The estimated cost of the south jetty extension was \$2,260,000, of the north jetty \$1,205,000, and of remodeling and operating dredge \$250,000. A revised estimate of \$3,529,300 as the cost of completing the south jetty extension was approved April 17, 1909. A revised estimate of \$5,966,573 as the cost of constructing the north jetty was approved July 18, 1913. The tidal range on the bar is about $7\frac{1}{2}$ feet.

Condition at the end of fiscal year.—The south jetty extension was completed during the fiscal year 1914. At the end of the year the jetty stood at or above project height throughout practically its entire length. The north jetty trestle was completed in July, 1915. At the end of the year 2,286,142 tons of stone had been placed in the jetty; for the first 8,200 linear feet its average height is from 12 to 16 feet above datum, for the next 4,000 feet it is 25 feet above datum, from here for the last 100 feet the enrockment slopes abruptly to 26 feet below datum. The side slopes are quite steep, so that storms would soon flatten the jetty to below project height. The project is about 87 per cent completed. The work remaining to be done consists in placing approximately 1,250,000 tons of stone in the north jetty.

At the end of the year the governing depth at mean lower low water on the main entrance range was 36 feet, on the southerly entrance range 31 feet, and on the northerly entrance range 31 feet. The maximum draft that could be carried across the bar June 30, 1916, at mean lower low water with smooth bar, was 30 feet. There has been expended by the United States on the existing project to the end of the fiscal year \$12,476,520.02 in addition to \$475,000 and \$25,000 contributed by the ports of Portland and Astoria, respectively. Of this amount \$11,076,218.57 was for new work (\$7,625,397.70 for south jetty extension and \$3,450,820.87 for north jetty), and \$1,900,301.45 for maintenance (\$692,277.92 for south jetty and \$1,208,023.53 for surveys and dredging).

Local cooperation.—The existing project contains no conditions requiring local cooperation. However, during 1914 the port of Portland contributed \$475,000 and the port of Astoria \$25,000 to this improvement. These amounts have been expended, the greater part having been applied to the purchase of stone for the north jetty. For work on terminals, etc., done with local funds, see report on Columbia and lower Willamette Rivers.

Effect of improvement.—The improvement has made it possible for the largest vessels operating on the Pacific coast to enter and leave at all normal stages of tide and in any weather except during the most severe storms. Bar-bound vessels, once so common, are now, on account of improved conditions, rarely to be seen.

Proposed operations.—The funds available will be exhausted about April 30, 1917, and will be expended as follows:

New work:		
738,000 tons stone in place, at \$1.50	\$1,107, 000	
Engineering and contingencies	111, 000	
		\$1, 218, 000
Maintenance:		
Operation of <i>Chinook</i> , 4½ months, at \$15,000	65, 000	
Engineering and contingencies	7, 000	
		72, 000
Total		1, 290, 000

With the funds for which estimate is submitted it is proposed to complete the north jetty and dredge on the bar to June 30, 1918, as follows:

New work:		
500,000 tons stone in place, at \$1.50	\$750, 000	
Engineering and contingencies	75, 000	
		\$825, 000
Maintenance:		
Operation of <i>Chinook</i> , nine months, at \$15,000	135, 000	
Engineering and contingencies	15, 000	
		150, 000
Total		975, 000

Commercial statistics.—Foreign exports during 1915 were mainly barley, flour, lumber, oats, and wheat; foreign imports principally bags and burlap, fiber, rice, seeds, and sulphur. The domestic commerce consisted mainly of asphaltum, cement, dairy products, flour, iron and steel, logs, lumber, merchandise, mill feed, fuel oil, paper, sugar, and wheat.

Comparative statement.

Calendar year.	Short tons.	Estimated value.
1913.....	3, 089, 218	\$66, 599, 192
1914.....	2, 719, 080	68, 042, 038
1915.....	2, 543, 521	86, 053, 771

All classes of commerce are affected by the improvement. Of the total tonnage, 7 per cent was carried in steamers to and from foreign ports, 17 per cent in sailing vessels to and from foreign ports, and 76 per cent in coastwise steamers.

Amount expended on all projects from July 5, 1884, to June 30, 1916:	
New work	\$13, 062, 471. 71
Maintenance	1, 900, 301. 45
Total	14, 962, 773. 16
Balance available for fiscal year ending June 30, 1917	1, 290, 032. 63
Amount (estimated) required to be appropriated for completion of existing project	1,230, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918:	
For works of improvement	825, 000. 00
For maintenance of improvement	150, 000. 00
Total	975, 000. 00

CLATSKANIE RIVER, OREG.

Location and description.—The Clatskanie River rises in the Coast Range in the State of Oregon, flows northwesterly about 28 miles and empties into the Columbia River, through Beaver and Wallace Sloughs, 65 miles below Portland.

Existing project.—The existing project provides for dredging a channel 6 feet deep at low water, with a bottom width of 40 feet from Clatskanie to the railroad bridge (about three-fourths of a mile), at a cost of \$4,200 and \$1,000 annually for maintenance. This project (H. Doc. No. 633, 61st Cong., 2d sess.) was adopted by the river and harbor act of June 25, 1910.

The variation of water level due to tides is about 4 feet at Clatskanie. For latest published map of Clatskanie River see House Document No. 698, Sixty-fourth Congress, first session.

The stretch included in the project is from Clatskanie to the railroad bridge (three-fourths of a mile), about three-fourths of a mile above the mouth. The variation of water level due to tides is about 4 feet at Clatskanie. For latest published map see House Document No. 698, Sixty-fourth Congress, first session.

Condition at the end of fiscal year.—The project was completed during the fiscal year 1911. The work consisted in dredging and cutting new channels through two sharp bends below the town of Clatskanie. At the end of the fiscal year a maximum draft at low water of about 4 feet could be carried to Clatskanie. The total amount expended on the existing project to the end of the fiscal year was \$7,445.47, of which \$4,299.93 was for new work and \$3,145.54 for maintenance.

Local cooperation.—The existing project contains no conditions requiring local cooperation. The Columbia Agricultural Co. and the citizens of Clatskanie, however, subscribed funds which were expended in dredging a cut-off of project width and depth and approximately 1,000 feet long across a bend near the mouth of the river and in other dredging in Clatskanie River and Beaver Slough.

Effect of improvement.—The improvement provides a cheaper and more direct means of transportation to the country about Clatskanie than does the railroad.

Proposed operations.—The funds available will be exhausted about March 4, 1917, and will be expended as follows:

Maintenance:

Operation of dredge <i>Monticello</i> and tender.....	\$800
Engineering and contingencies.....	200

Total	1, 000
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The funds for which estimate is submitted are for maintenance dredging for the fiscal year ending June 30, 1918, as follows:

Operation of dredge <i>Monticello</i> and tender.....	\$800
Engineering and contingencies.....	200

Total	1, 000
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The estimate is larger than the average expended for maintenance for the last three years, as the funds available during the working seasons of 1914 and 1915 were insufficient to carry on the work.

Commercial statistics.—The commerce during the calendar year 1915 was principally agricultural and dairy products, general merchandise, building materials, iron and steel, live stock, lumber, meats, mill feed, shingles, and fuel oil.

Comparative statement.

Calendar year.	Short tons.	Estimated value.
1913.....	25,404	\$742,729
1914.....	8,565	478,633
1915.....	9,490	399,035

All the commerce is affected by the improvement.

Amount expended on all projects from Mar. 3, 1899, to June 30, 1916:

New work.....	\$16,107.30
Maintenance.....	4,013.64

Total.....	20,120.94
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Balance available for fiscal year ending June 30, 1917.....	1,004.76
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Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....	1,000.00
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CLATSKANIE RIVER, OREG.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document No. 698, Sixty-fourth Congress, first session:

The Clatskanie River empties into Columbia River through Beaver Slough and Wallaces Slough. The distance from Clatskanie City to the Columbia River is 4 miles, $1\frac{1}{2}$ miles being in Clatskanie River, $1\frac{1}{2}$ miles in Beaver Slough, and 1 mile in Wallaces Slough. The existing project, adopted by the act of June 25, 1910, provides for dredging a channel 6 feet deep at low water and 40 feet wide at bottom from Clatskanie City to the railroad bridge. Below this bridge the channel has been improved by private interests and by the city of Clatskanie. The improvement now apparently desired is the dredging and maintenance by the United States of a through channel 6 feet deep and 40 feet wide, from Clatskanie City to Columbia River. The district officer, who is also the division engineer, estimates that such a channel will cost \$4,620 for original construction and \$2,000 per year for maintenance. He believes that the benefits to be expected from this improvement will warrant the expenditure involved, and therefore expresses the opinion that the locality is worthy of further improvement by the United States to the extent outlined.

I concur in the views of the district officer and the Board of Engineers for Rivers and Harbors and therefore report that the improvement by the United States of Clatskanie River, Oreg., from Clatskanie City to the Columbia River, is deemed advisable to the extent of providing and maintaining a channel 6 feet deep and 40 feet wide, at an estimated cost of \$4,620 for first construction and \$2,000 annually for maintenance.

ANACORTES HARBOR, WASH.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1117, Sixty-fourth Congress, first session:

Anacortes Harbor is on the northern point of Fidalgo Island in Puget Sound, and is formed by the waters of Guemes Channel on the north and those of Fidalgo Bay on the east of the city. The principal wharves are on the north where ample depths are available, but vessels using these waters are exposed to strong tidal currents. Anacortes is chiefly engaged in the lumber

and fish business. The large fishing fleet is composed mostly of small vessels, and a sheltered harbor would be of great benefit to them. The Cap Sante waterway is in Fidalgo Bay on the east side of the city. If this waterway were improved, it would provide the needed facilities, and local authorities have signified their willingness to cooperate in this work. The district officer submits an estimate of cost of securing a channel 12 feet deep at mean lower low water, 150 feet wide at the outer end and 250 feet wide at the inner end, within the limits indicated on the map herewith, at a total estimated cost of \$84,000. He expresses the opinion that, under certain conditions of local cooperation, the locality is worthy of improvement to the extent indicated, and the division engineer concurs in this view.

I concur in the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Anacortes Harbor, Wash., with a view to improving Cap Sante waterway * * *, is deemed advisable to the extent of providing a channel 12 feet deep at mean lower low tide, 150 to 250 feet wide, as shown on accompanying map, at an estimated cost of \$84,000, under the following conditions:

(a) That suitable dumping grounds for the deposit of dredged material and the necessary bulkheads to retain the material in place shall be furnished without cost to the United States.

(b) That before the work is commenced local interests shall contribute the sum of \$28,000 toward the execution of the work and furnish evidence satisfactory to the Secretary of War that they will provide a suitable terminal open to the public on equal and reasonable terms.

GRAYS HARBOR AND BAR ENTRANCE, WASH.

Location and description.—Grays Harbor is a bay 17 miles long from east to west and 14 miles wide at the mouth of the Chehalis River in the southwestern part of the State of Washington, 48 miles north of the entrance to the Columbia River. It is connected with the Pacific Ocean by a channel approximately 12,500 feet wide and 2 miles long, between Point Brown on the north and Point Hanson on the south.

Existing project.—The original and existing project, as published in the Annual Report of the Chief of Engineers for 1896, pages 3517–3523, was adopted by the river and harbor act of June 3, 1896. It contemplated a channel over the bar 24 feet deep at mean lower low water, to be obtained by the construction of a single high-tide rubble stone jetty on the south side of the harbor throat, extending out to sea a distance of 18,154 feet. The estimated cost was \$1,000,000. The project was modified by the river and harbor act of March 2, 1907, in accordance with plans published in Rivers and Harbors Committee Document No. 2, Fifty-ninth Congress, second session, which provided for a mid-tide jetty 9,000 feet long on the north side of the harbor throat, at an estimated cost of \$600,000. The project was again modified by the river and harbor act of June 25, 1910, in accordance with report published in Rivers and Harbors Committee Document No. 29, Sixty-first Congress, second session, which provided for continuing the improvement by extending the north jetty 7,000 feet, at an estimated cost of \$1,030,000. The mean tidal variation is 8 feet. The last published map of the locality is in the Annual Report of the Chief of Engineers for the fiscal year ending June 30, 1915, page 3424.

Conditions at the end of fiscal year.—The enrockment of the north jetty, raised during the year, is still at the level of ordinary high tide, except for a distance of about 500 feet at the outer end, where

wave action has lowered the enrockment to about the level of extreme low water. No work has been done on the south jetty since 1902, and the crest of the enrockment remains at or below extreme low water throughout practically its entire length. The approved project for which appropriations have been made is completed. On June 30, 1916, there was a channel across the bar in a favorable location not less than 500 feet wide and of project depth of 24 feet at mean lower low water. At the close of the fiscal year \$2,609,205.17 had been expended for improvement and \$617,778.09 for maintenance, making a total of \$3,226,983.26.

Local cooperation.—No local cooperation was required by law. The necessary land for trestle approach and operating plant was donated to the United States by local interests. With funds voluntarily contributed by the port of Grays Harbor commission and expended by this office, the U. S. dredge *P. S. Michie* was employed from December 2, 1915, to February 5, 1916, and during favorable weather worked on the bar. She removed 56,939 cubic yards of material, and the channel for a width of about 600 feet was increased in depth by approximately 5 feet. The total cost of the *Michie's* operations was \$14,066.95.

Effect of improvement.—The effect of the improvement has been to permit the use of larger and more economical vessels suitable for export trade and to open up better markets for extensive timber products of Grays Harbor. No direct reduction in freight rates has been made, so far as known.

Proposed operations.—No work is contemplated except supervision, care of plant, and semiannual surveys. The funds available will be required for care of plant to March 4, 1917. The funds for which estimate is submitted will be required as follows:

Care of plant, Mar. 4, 1917, to June 30, 1918	\$2,000
Supervision and surveys	5,500
Total	7,500

Commercial statistics.—The commerce consists mostly of the exportation of lumber, lumber products, and sea foods, and the importation of foodstuffs.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	666,593	\$5,890,475
1914.....	729,527	5,729,508
1915.....	502,410	5,907,545

Amount expended on all projects from June 3, 1896, to June 30, 1916:

New work	\$2,609,205.17
Maintenance	617,778.09
Total	3,226,983.26

July 1, 1916, balance available	2,004.25
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	7,500.00

GRAYS HARBOR BAR, WASH.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1729, Sixty-fourth Congress, second session:

Grays Harbor has been under improvement since 1896, when a project was adopted providing for a south jetty with a view to securing a depth of 24 feet on the bar. This jetty was built to a length of 13,734 feet. The project was extended by the act of March 2, 1907, to include a north jetty, which has since been built to a length of 17,000 feet. These works have not resulted in securing and maintaining a channel of project dimensions, and the actual navigable depth has varied from about 12 feet to 26 feet. With a view to increasing the depth and fixing the channel in position the district officer proposes an extension of the north jetty for a distance of 5,500 feet at an estimated cost of \$1,775,000. He believes that such further improvement is worthy of being undertaken by the United States, provided the port commission will repair the trestle of the north jetty and construct proper unloading facilities at Aberdeen. The division engineer concurs in the views expressed by the district officer. The special board appointed for the purpose of making a further investigation of conditions at this harbor believes that neither an extension of the south jetty nor of the north jetty would result in commensurate benefits, and that to secure and maintain the project channel both dredging and jetties will be required. It recommends the immediate restoration of the north jetty at an estimated cost of \$560,000; the restoration of the south jetty at an estimated cost of \$870,000; and the purchase or construction of a suitable dredge for work on the bar at an estimated cost of \$450,000 and its operation at an annual estimated cost of \$82,500.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated August 8, 1916. During the period of nearly two years which has elapsed since the report of the special board was submitted the enrockment of the north jetty has been raised to or above the plane of ordinary high water for its entire length at a cost of about \$580,000. Recent surveys have indicated a much improved condition of the channel, and it appears probable that with the aid of the recently repaired north jetty dredging alone may be sufficient to maintain the channel for many years, if not indefinitely. The board therefore believes that it is advisable to provide an efficient dredge and give it a thorough trial for a number of years before making further large expenditures on the jetties. Under present conditions in the shipbuilding industry, however, the board is of opinion that the estimated cost of the dredge should be increased to \$700,000.

After due consideration of the above-mentioned reports I concur in the views of the Board of Engineers for Rivers and Harbors, and therefore report that it is deemed advisable to modify the existing project for improvement of Grays Harbor Bar, Wash., so as to provide for the construction or purchase of a sea-going dredge for use on the bar at an estimated cost of \$700,000 and a subsequent annual cost of \$85,000 for operation.

WATERWAY CONNECTING PORT TOWNSEND BAY AND OAK BAY, WASH.

Location and description.—The canal is to connect two bays which are arms of Admiralty Inlet, on the west side of Puget Sound, in the northwestern part of the State of Washington, about 40 miles north of Seattle.

Existing project.—The present project, printed in House Document No. 625, Sixty-second Congress, second session, was adopted by the river and harbor act of March 4, 1913. It contemplates dredging a canal 15 feet deep at mean lower low water, 75 feet wide on the bottom for about 4,800 feet, and the construction of jetties to protect the channel at the southern, or Oak Bay, end and a bulkhead for the retention of dredged material. The estimated cost was \$62,500.

Condition at the end of fiscal year.—The project has been completed and a channel of specified dimensions obtained. The total expenditure was \$73,322.35 for improvement and \$4,000 for maintenance, making a total of \$77,322.35.

Local cooperation.—The act adopting the project required local interests to furnish a right of way and provide suitable places of deposit for dredged material. These conditions were complied with and accepted by the Chief of Engineers on September 8, 1914.

Effect of improvement.—The improvement has had no effect on freight rates, but has provided a sheltered passage for light-draft boats plying between up-Sound ports and points on Port Townsend Bay, and the free passage of log tows under weather conditions when they would otherwise be storm bound in Port Townsend Bay from 1 to 10 days, as they could not be towed past Marrowstone Point.

Proposed operations.—As the banks of the channel have not yet become stable, some redredging will probably be necessary. A custodian should also be appointed to enforce speed regulations on vessels using the canal and for the collection of commercial statistics. Available funds will be expended for supervision and inspection. The funds to be provided are: For custodian, \$500; redredging, \$4,500.

Commercial statistics.—The canal is extensively used by vessels of all descriptions, as many as 90 having been counted passing through the canal during the daylight hours of one day. Accurate commercial statistics can not be obtained except by the appointment of a custodian for the canal.

Calendar year.	Short tons.	Value.
1915.....	65, 273	\$510, 906

Amount expended on all projects from March 4, 1913, to June 30,

1916:

New work.....	\$73, 322. 35
Maintenance.....	4, 000. 00
Total.....	77, 322. 35

July 1, 1916, balance unexpended..... 177. 65

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement..... 5, 000. 00

LAKE WASHINGTON SHIP CANAL, WASH.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 800, Sixty-fourth Congress, first session:

The existing project for the improvement of the waterway, adopted by the act of June 25, 1910, provides for the construction by the United States of a double lock and dam, with necessary accessory works, at the Narrows at the entrance to Salmon Bay, and for the excavation by King County, or other local agency, of a channel 75 feet wide and 25 feet deep at low water from the locks into Lake Washington. The project was modified by the act of March 4, 1913, to authorize the dredging of a channel of the same dimensions from the locks to deep water in Puget Sound. The original estimate of cost was \$3,334,709, the cost of the locks to be constructed by the United States being \$2,275,000. These locks are nearing completion, and a channel from them to Lake Union has been excavated by local interests to a depth of 36 feet at low water and not

less than 100 feet wide on bottom, and between Lake Union and Lake Washington a channel has been excavated not less than 100 feet wide on bottom, and from 30 to 36 feet deep. The south side of the latter channel has been revetted by local interests for a distance of about 1,000 feet. While the act of March 4, 1913, authorizes dredging by the United States below the locks there are no funds available for this work. In the channel being constructed by local interests, provision is made for accommodation of vessels of the deepest draft that can be passed through the locks, and the district officer is of opinion that the dimensions of the channel below the locks should be not less than 30 feet at extreme low water, and the width on bottom not less than 150 feet, with suitable widening at the turn below the Great Northern Bridge and a suitable dike on the north side of the channel. For reasons given he believes that it is advisable torevet the banks between the head of Salmon Bay and Lake Union and the north side of the channel between Lake Union and Lake Washington. The total estimated cost of the work proposed is \$789,400. The district officer expresses the opinion that all of the work is justified at the expense of the United States, without additional cooperation on the part of local interests, and should be undertaken and completed at the earliest possible date. The division engineer concurs in the views expressed by the district officer.

The Board of Engineers for Rivers and Harbors concurs in general with the views of the district officer and the division engineer, but does not believe that it is essential to construct the proposed dike on the north side of the entrance channel. Omitting this work, the estimate becomes in round numbers \$657,000.

I concur in the views of the Board of Engineers for Rivers and Harbors, and therefore report that the further improvement by the United States of the Lake Washington Ship Canal, Wash., is deemed advisable to the extent of providing a channel below the locks 30 feet deep at extreme low water, revetting the banks of the canal between the head of Salmon Bay and Lake Union, and the north bank between Lake Union and Lake Washington, approximately as indicated on accompanying maps, at an estimated cost of \$657,000.

COWLITZ AND LEWIS RIVERS, WASH.

(A) COWLITZ RIVER.

Location and description.—The Cowlitz River rises in the Cascade Range, in the State of Washington, flows westerly and southerly about 100 miles and empties into the Columbia River about 45 miles below Portland.

Existing project.—The existing project contemplates obtaining by dredging a channel 50 feet wide and 4 feet deep from the mouth to Ostrander (9 miles) and 50 feet wide and $2\frac{1}{2}$ feet deep thence to Castle Rock (10 miles above Ostrander); thence by dredging, snagging, and the construction of a number of regulating works, a channel not less than 40 feet wide and $2\frac{1}{2}$ feet deep at low water to Toledo (37 miles above the mouth). The estimated cost was \$31,600 for new work and \$6,000 annually for maintenance. This project (H. Doc. No. 1167, 60th Cong., 2d sess., with maps, and H. Doc. No. 404, 61st Cong., 2d sess., without maps) was adopted by the river and harbor act of June 25, 1910. A revised estimate of \$39,100 as the cost of completing the project was approved June 28, 1912. The variation of water level due to tides is from 4 feet at the mouth to zero at Ostrander.

The stretch included in the project is from Toledo to the mouth (37 miles). For latest published map, see House Document No. 1167, Sixtieth Congress, second session.

Condition at the end of fiscal year.—The project was completed during the fiscal year 1914 at a cost of \$34,394.29; this was \$4,705.71 less than the revised estimate of 1912. The work consisted in dredging, construction of and repairs to regulating works, and the removal of snags and other obstructions to navigation. At the end of the fiscal year a maximum draft of about 24 inches, an increase of about

10 inches, could be carried at low water to Toledo. At extreme low water during September and October steamboat navigation above Castel Rock is usually suspended. The total amount expended on the existing project to the end of the fiscal year was \$54,416.14, of which \$34,394.29 was for new work and \$20,021.85 for maintenance.

Local cooperation.—The existing project contains no conditions requiring local cooperation. Since 1898 persons interested in the improvement of the river have furnished the funds for and built a total of approximately 1,900 linear feet of pile, brush, and rock jetties at Monticello, Clarks, Ostrander, Old Lexington, and Big Sandy Bars, at an estimated cost of \$8,400.

Effect of improvement.—The channel to Toledo is navigable at a lower stage of water than formerly, and the period during which navigation is not possible and during which freight for Toledo must be brought in by rail to Winlock and by wagon thence to Toledo is thus reduced. The wagon haulage is \$2.50 per ton.

Proposed operations.—The funds available will be exhausted about March 4, 1917, and will be expended as follows:

Maintenance:	
Operation of dredge <i>Monticello</i> and tender, 2 months	\$3, 000
Construction of and repairs to auxiliary works	4, 500
Engineering and contingencies	700
Total	8, 200

The funds for which estimate is submitted are for maintenance for the fiscal year ending June 30, 1918, as follows:

Operation of dredge <i>Monticello</i> and tender	\$3, 000
Construction of and repairs to auxiliary works	2, 400
Engineering and contingencies	600
Total	6, 000

The estimate is larger than the average expended for maintenance for the last three years, but the channel has not been properly maintained since the completion of the project in 1914 on account of shortage of funds.

Commercial statistics.—The commerce during the calendar year 1915 was principally agricultural implements, automobiles, building materials, household goods, live stock, general merchandise, flour, mill feed, potatoes, shingles, lumber, and logs.

Comparative statement.

Calendar year.	Short tons.	Estimated value.
1913.....	399, 079	\$3, 962, 365
1914.....	221, 936	1, 997, 322
1915.....	194, 325	1, 374, 124

Amount expended on all projects from June 14, 1880, to June 30, 1916:	
New work	\$39, 393. 25
Maintenance	68, 205. 78
Total	107, 599. 07
Balance available for fiscal year ending June 30, 1917	8, 243. 65
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	6, 000. 00

(B.) LEWIS RIVER.

Location and description.—The Lewis River rises in the Cascade Range in the State of Washington, flows westerly, and empties into the Columbia River about 26 miles below Portland.

Existing project.—The existing project provides for obtaining by dredging and by the construction of regulating works a low-water channel 6 feet deep and 50 feet wide to the forks ($3\frac{3}{4}$ miles), 4 feet deep and 50 feet wide on the East Fork from its mouth to La Center (3 miles), 4 feet deep and 50 feet wide on the North Fork from its mouth to Woodland ($3\frac{1}{2}$ miles), and for clearing the channel to Runyon (23 miles above Woodland), at an estimated cost of \$61,500 for new work and \$6,000 annually for maintenance. This project (H. Doc. No. 28, 62d Cong., 1st sess.) was adopted by the river and harbor act of March 4, 1913. For latest published map of Lewis River see page 3557 of Annual Report for 1904.

The variation of water level, due to tides, ranges from about 2 feet at the mouth to $1\frac{1}{2}$ feet at La Center and zero at Woodland. The stretches included in the project are from La Center on the East Fork to its mouth (3 miles) and from Runyon on the North Fork to the mouth of the river (about 30 miles). For latest published map see page 3557 of Annual Report for 1904.

Condition at the end of fiscal year.—Dredging on the East Fork to the project depth was completed during the fiscal year 1914. At the end of the year the project was about 33 per cent completed. The work consisted in dredging and in the removal from the channel of snags and other obstructions. This has extended the period of low-water navigation; at the end of the year a draft of about 3 feet at low water could be carried to La Center on the East Fork and to Woodland on the North Fork. The work remaining to be done consists in dredging, bank revetment, and construction of auxiliary regulating works. The total amount expended on the existing project to the end of the fiscal year was \$20,207.66, of which \$11,252.76 was for new work and \$8,954.90 for maintenance.

Local cooperation.—The improvement of the North Fork under the existing project is contingent upon a suitable dock and warehouse being provided at Woodland by the local authorities. This requirement has been met by the town of Woodland in the purchase of the dock and river front property formerly owned by the Lewis River Navigation Co. At La Center on the East Fork the dock and warehouse are owned by the municipal authorities and were built by public subscription at a cost of about \$1,500. On the North Fork, about one-half mile below Woodland, the county authorities have expended approximately \$10,000 on bank revetment, and the Lewis River Boom & Logging Co. has built three pile and brush jetties about 1 mile above the mouth at an estimated cost of \$1,500.

Effect of improvement.—Freight rates to La Center have been reduced by at least \$1 per ton, the transfer and rehandling of freight formerly necessary during the low-water period of the East Fork having been eliminated. The improvement of the North Fork has extended the period of low-water navigation, thus absorbing the transfer charge of \$1 per ton at Pekin Landing below Woodland.

Proposed operations.—The funds available will be exhausted about March 4, 1917, and will be expended as follows:

New work:		
Operation of dredge <i>Monticello</i> and tender, 2 months-----	\$3, 000	
Construction of auxiliary works-----	6, 500	
Engineering and contingencies-----	900	
		----- \$10, 400
Maintenance:		
Operation of dredge <i>Monticello</i> and tender, 2 months-----	3, 000	
Engineering and contingencies-----	300	
		----- 3, 300
Total-----		13, 700

The funds for which estimate is submitted are for the fiscal year ending June 30, 1918, as follows:

New work:		
Operation of dredge <i>Monticello</i> and tender, 2 months-----	\$3, 000	
Construction of wing dams, bank revetment, etc-----	9, 300	
Engineering and contingencies-----	1, 200	
		----- \$13, 500
Maintenance:		
Operation of dredge <i>Monticello</i> and tender, 2 months-----	3, 000	
Construction of and repairs to wing dams-----	1, 100	
Engineering and contingencies-----	400	
		----- 4, 500
Total-----		18, 000

No maintenance under the existing project was required during the fiscal year 1914, as the improvement was not far enough advanced. No maintenance work was done during 1915 on account of shortage of funds and lack of suitable plant. The amount expended for maintenance during 1916 (\$8,954.90) is a fair indication of the amount required for two years' maintenance.

Commercial statistics.—The commerce during the calendar year 1915 was principally agricultural implements, building materials, dairy and agricultural products, flour, fruit, grain, gasoline, live stock, mill feed, and general merchandise.

Comparative statement.

Calendar year.	Short tons.	Estimated value.
1913.....	187, 416	\$2, 279, 711
1914.....	46, 211	1, 399, 557
1915.....	22, 525	1, 554, 924

Amount expended on all projects from Mar. 3, 1899, to June 30, 1916:	
New work-----	\$33, 504. 38
Maintenance-----	17, 053. 28
Total-----	50, 557. 66
Balance available for fiscal year ending June 30, 1917-----	13, 720. 06
Amount (estimated) required to be appropriated for completion of existing project-----	40, 000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1918:	
For works of improvement-----	13, 500. 00
For maintenance of improvement-----	4, 500. 00
Total-----	18, 000. 00

CONSOLIDATED.

Amounted expended on all projects from June 14, 1880, to June 30, 1916:

New work -----	\$72, 897. 67
Maintenance -----	85, 259. 06
Total -----	<u>158, 156. 73</u>
Balance available for fiscal year ending June 30, 1917 -----	21, 963. 71
Amount (estimated) required to be appropriated for completion of existing project -----	<u>40, 000. 00</u>
Amount that can be profitably expended in fiscal year ending June 30, 1918:	
For work of improvement -----	13, 500. 00
For maintenance of improvement -----	10, 500. 00
Total -----	<u>24, 000. 00</u>

SKAGIT RIVER, WASH.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 935, Sixty-third Congress, second session:

Skagit River is a tributary of Puget Sound, which it enters through Skagit Bay. The mouth of the river is of delta formation, the most important outlets being the North Fork and the South Fork. The river has been improved to the extent of removing snags and similar obstructions to navigation since 1882, under appropriations for Puget Sound and tributary waters. An independent project was adopted by the act approved June 25, 1910, providing for the construction of a training dike from the mouth of the South Fork across the flats to deep water in Saratoga Passage, regulating dikes and mattress sill near the head of the North Fork, and closing subsidiary channels at the delta of the river. Improvements are now desired at Sterling Bend, a short distance below Sedro Woolley, where a cut-off occurred in 1911, greatly disturbing the regimen of the stream, and at Skagit City bar, a short distance below Skagit City, where the river is wide and shallow. The results of the survey show an unstable condition of the river in the vicinity of the cut-off and indicate that it would be impracticable to improve the river at this point so as to provide useful navigation at reasonable cost, and the district officer therefore expresses the opinion that no work of improvement should be undertaken by the United States at this locality further than already carried on under the project for improving Puget Sound and its tributary waters. He presents a plan for the improvement of Skagit City bar by the construction of about 6,200 feet of dike to concentrate the flow, at an estimated cost of \$61,500 and \$5,000 annually for maintenance. Practically all of the commerce of the river is affected by the shoal condition at this bar, and the district officer reports that in his opinion it is advisable to undertake this work, provided local interests cooperate to the extent of undertaking any bank protection that may be required for the maintenance of the dikes or levees which have been built by local interests along the banks of the stream. The division engineer concurs with the views of the district officer.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated April 21, 1914. The board believes that the amount of commerce justifies the improvement of this bar by combined dredging operations and training walls, but it believes that the main reliance should be placed upon dredging, and that training walls should be used only to supplement the dredging and to restrain the dredging spoils, experience to serve as a guide as to the actual location and extent of construction of the training walls, as suggested by the district officer. It therefore recommends that the existing project for the Skagit River be modified so as to include the improvement of Skagit City bar as outlined above, at a cost not exceeding \$30,000.

I concur with the views of the Board of Engineers for Rivers and Harbors, and therefore report that it is deemed advisable to modify the existing project

for improvement of Skagit River, Wash., to include the improvement of Skagit City bar by combined dredging operations and training walls, in the manner proposed by the board as expressed above, at a cost not exceeding \$30,000.

SKAMOKAWA CREEK, WASH.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 111, Sixty-third Congress, first session:

Skamokawa Creek rises in the heavily timbered hills lying to the north of the Columbia River, and empties into that river at a point about 34 miles from the mouth and at the lower end of Steamboat Slough, an arm of the Columbia. The creek has three branches which unite about $1\frac{1}{2}$ miles above its mouth. These branches are too small and crooked for any navigation, but the lower portion of Skamokawa Creek below the forks is a tidal slough having channel depths of $2\frac{1}{2}$ to 6 feet at low water from Steamboat Slough to Brooks Slough and depths of 1 to 10 feet thence to the forks. The district officer states that interested parties desire a channel about 150 feet wide and 20 feet deep at low water at the lower entrance to Steamboat Slough and a channel about 75 feet wide on the bottom with a depth of about $6\frac{1}{2}$ feet across the bar from the mouth of Brooks Slough to Steamboat Slough. He finds no commercial need for the proposed deepening to 20 feet of the channel at the lower entrance to Steamboat Slough and therefore does not recommend this improvement. It appears that on account of the shallow bar in Skamokawa Creek between Steamboat Slough and Brooks Slough boats engaged in towing logs are seriously delayed and inconvenienced. The cost of dredging a channel through this bar 75 feet wide on the bottom and $6\frac{1}{2}$ feet deep at low water is estimated by the district officer at \$1,800, with \$600 per annum for maintenance. In view of the moderate cost of the work and the probable benefits to result therefrom, he is of opinion that it is advisable for the United States to undertake the improvement. The division engineer concurs with the views of the district officer.

I concur in general with the views of the district officer, the division engineer, and the Board of Engineers for Rivers and Harbors, and therefore, in carrying out the instructions of Congress, I report as follows: That the improvement by the United States of Skamokawa Creek, Wash., is deemed advisable so far as to secure an available channel depth of $6\frac{1}{2}$ feet and a width of 75 feet, increased at entrances and on curves, across the bar from the mouth of Brooks Slough to Steamboat Slough, following in general the methods described in the report of the district officer, at an estimated cost of \$1,800 for first construction and \$600 annually for maintenance.

GRAYS RIVER, WASH.

Location and description.—Grays River rises in the Coast Range in the State of Washington, flows southwesterly about 30 miles, and empties into Grays Bay, in the estuary of the Columbia River nearly opposite the city of Astoria.

Existing project.—The existing project provides for the removal of snags and other obstructions from the channel and overhanging trees from the banks between the mouth and the town of Grays River (8 miles), at a cost of \$2,500. No estimate for maintenance is given. This project (River and Harbor Committee Doc. No. 1, 59th Cong., 2d sess.) was adopted by the river and harbor act of March 2, 1907. Tidal changes vary from 5 to 8 feet at the mouth to about 2 feet less at the town.

Condition at the end of fiscal year.—The project was completed during the fiscal year 1909 at the estimated cost of \$2,500. The work consisted in the removal of snags from the channel and overhanging trees from the banks and in scraping some of the shoals. At the end of the fiscal year there was a good navigable channel to the town of Grays River, over which a maximum draft of about 3 feet could be

carried at mean low water. The total amount expended on the existing project to the end of the fiscal year was \$3,857.23, of which \$2,500 was for new work and \$1,357.23 for maintenance.

Effect of improvement.—Freight rates are not materially affected, but the channel is safe and easy of navigation at a lower stage of water than prior to the improvement.

Proposed operations.—The funds available will be exhausted about June 30, 1917, and will be expended for maintenance, as follows:

Snagging and removing overhanging trees from banks----- \$640

The funds for which estimate is submitted are for maintenance for the fiscal year ending June 30, 1918, as follows:

Snagging and removing overhanging trees from banks----- \$500

This amount is larger than the average expended for maintenance for the last three years, but it is the minimum amount that can profitably be expended.

Commercial statistics.—The commerce during the calendar year 1915 was principally agricultural and dairy products, general merchandise, building materials, iron and steel, fuel oil, live stock, shingles, lumber, and logs.

Comparative statement.

Calendar year.	Short tons.	Estimated value.
1913.....	194,264	\$1,123,795
1914.....	143,337	1,034,536
1915.....	59,618	663,993

Amount expended on all projects from Mar. 2, 1907, to June 30, 1916:

New work----- \$2,500.00

Maintenance----- 1,357.23

Total----- 3,857.23

Balance available for fiscal year ending June 30, 1917----- 642.77

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement----- 500.00

LAKE RIVER, WASH.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 1176, Sixty-third Congress, second session:

Lake River is a tributary of Columbia River, which it enters near the mouth of Lewis River about 26 miles below Portland, Oreg. It has a total length of about 11 miles. Ridgfield, about 3 miles above the mouth, is the head of regular steamboat navigation. Below this point there is a low-water depth of not less than 6 feet except at the mouth, where the depth is about $3\frac{1}{2}$ feet. The district officer submits a plan providing for a channel in Lake River 50 feet wide and 6 feet deep at low water, and a channel in Bachelors Slough 50 feet wide and 4 feet deep at low water, with necessary snagging, at an estimated cost of \$4,850, the cost of the two improvements separately being approximately \$1,600 for Lake River and \$3,250 for Bachelors Slough. He expresses the opinion that the locality is worthy of improvement to this extent.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith dated September 15, 1914. From its study of the subject, the board reaches the

conclusion that the cost of the work in Bachelors Slough is excessive when compared with the probable resulting benefits, and that a channel through this slough, while convenient, is not essential for the boats engaged in traffic on Lake River, as that stream is accessible at its mouth from the Columbia River. The board concurs with the district officer, however, in the opinion that it is advisable to undertake the improvement of Lake River, in the manner proposed, at an estimated cost of \$1,600.

I concur with the views of the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Lake River, Wash., is deemed advisable to the extent of providing a channel 50 feet wide and 6 feet deep at low water, from the mouth to Ridgefield, at an estimated cost of \$1,600 for first construction and \$500 annually for maintenance.

PUGET SOUND AND ITS TRIBUTARY WATERS, WASH.

Location and description.—Puget Sound is an arm of the Pacific Ocean, located in the western part of the State of Washington. This improvement includes maintenance work on all the larger rivers emptying into Puget Sound, the principal ones being the Skagit, Snohomish, Snoqualmie, Skykomish, Stilaquamish, Nooksak, Puyallup, and Duwamish, and connecting navigable sloughs.

Existing project.—The present project was adopted by the river and harbor act of July 13, 1892, and contemplates maintenance work on the rivers tributary to Puget Sound by snagging and dredging. The latest map of the locality is published in Annual Report of the Chief of Engineers for fiscal year 1913.

Condition at the end of fiscal year.—The work has consisted of snagging and dredging in the principal tributaries of Puget Sound. The snag boat *Skagit*, constructed in 1883, was operated practically continuously to March 1, 1915, when she was dismantled and sold. The snag boat *Swinomish*, constructed under contract, was placed in operation on March 1, 1915, and snagging was carried on in rivers and sloughs tributary to Puget Sound and dredging was done to restore channel depths. No permanent results are obtainable, but the maintenance of existing channels requires continuous operation of the boat. A dike has been built at Hat Slough to reduce the flow from that outlet of the Stilaguamish River, and a low-water dike was built at the north fork of the Skagit River to reduce the stream flow through that mouth and reduce deterioration of the south channel of the Skagit. Repairs to these dikes have been made as necessary. The total expenditures, under the existing project, are \$43,336.92 for new work and \$411,204.13 for maintenance, making a total of \$454,541.05.

Local cooperation.—There has been no local cooperation on this work.

Effect of improvement.—There has been no direct effect on freight rates, but the snagging and dredging by the snag boat has kept the rivers open to navigation for steamers and for the towing and rafting of timber.

Proposed operations.—The snag boat *Swinomish* will be operated on Puget Sound and its tributary waters as may be necessary to maintain existing channels. Funds now available will be expended in operation of the boat by March 1, 1917. The funds for which estimate of \$25,000 is submitted will be required for operating the snag boat between March 1, 1917, and June 30, 1918. The normal cost of operation of the snag boat is \$1,500 per month.

Commercial statistics.—The water traffic on Puget Sound and its tributary waters is very large and is rapidly growing. It includes vessels of about every type and size in use throughout the world. The foreign commerce consists mostly of the exportation of lumber, grain, fish, flour, and dairy products, and the importation of tea, silks, and hemp.

Comparative statement of commerce of tributary waters not included in statistics for specific improvements.

Calendar year.	Short tons.	Value.
1913.....	105,329	\$1,084,813
1914.....	113,990	815,039
1915.....	55,057	543,161

Amount expended on all projects from August 2, 1882, to June 30,

1916:

New work.....\$43,336.92
Maintenance.....478,699.71

Total.....522,036.63

July 1, 1916, balance unexpended.....18,058.62

Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement.....25,000.00

APOON MOUTH, YUKON RIVER, ALASKA.—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document No. 991, Sixty-third Congress, second session:

The Apoon mouth is the most easterly of the delta channels into which the Yukon River divides, and is used by all vessels plying between points on the river and the port of St. Michael. The original and existing project for improvement of this branch of the river, adopted by the act approved July 25, 1912, provides for a channel 6 feet deep at mean low water, 150 feet wide through the bars, and 200 feet wide at the bends. The present improvement extends to the mouth of Pastolik River, and the improvement contemplated by the act is understood by the district officer to extend from the mouth of that river to deep water for river vessels, or to a depth of approximately 6 feet below mean lower low water. He states that not only would the first cost of a suitable channel across these extensive flats at the mouth of the river be excessive, but its maintenance would also be impracticable within reasonable limits of cost. He therefore expresses the opinion that the additional improvement now proposed is not worthy of being undertaken by the General Government, and in this view the division engineer concurs.

These reports have been referred, as required by law, to the Board of Engineers for Rivers and Harbors, and attention is invited to its report herewith, dated May 6, 1914. At a hearing held by the board on February 24, 1914, interested parties expressed a desire for the widening of the channel at the turn opposite the mouth of the Pastolik River, the removal of such shoaling as had occurred in the improved reaches, and the dredging of a shallow channel through the so-called "hogback" or crest of the shoal a short distance beyond the mouth of the river, and these improvements are discussed in the supplemental report of the district officer, dated April 17, 1914. The board states that the work of restoring the channel where dredging has been done, and of easing the point complained of, can be done under the existing project with funds now on hand. The removal of the "hogback" would be new work, and its cost is considered excessive when compared with resulting benefits. The board therefore expresses the opinion that it is not advisable for the United

States to undertake the improvement of this locality to a greater extent than is authorized by the existing project.

After due consideration of the above-mentioned reports, I can not concur with them in their limitation. I think that it would be justifiable to go further in the improvements than the local eningeer and the Board of Engineers for Rivers and Harbors have recommended. I have been in Alaska and am familiar with the character of the navigation on the Yukon, and know that the improvement is a vital one, and it affects the welfare of the whole Territory. Ocean navigation must end at St. Michael, and there the mode of transportation must be changed from ocean steamers to river steamboats and barges. These are light, fragile structures, such as are found on the tributaries of the Mississippi River. The trip of a steamboat towing barges and carrying freight and passengers from St. Michael to the Yukon River is not without peril, and the danger is augmented if it reaches the Apoon Pass and is not able to enter the sheltered waters in the river, but is forced to wait for favorable conditions of wind and tide. An increase of depth a foot or two is of the greatest value and importance to such vessels, and may determine the question of success or failure of a transportation line. All work is expensive in Alaska, and any improvement in transportation facilities is valuable in proportion to the increased cost of everything there.

I am of the opinion that such expenditure would be justifiable as is necessary to provide for the removal of such shoaling as has occurred in the improved reaches, and for widening and straightening the channel at the turn opposite the mouth of the Pastolik River, and for dredging a channel through the so-called "hogback" a short distance beyond the mouth of the river. From the district officer's supplemental report of April 17, 1914, it appears that the cost of dredging a channel through the "hogback" sufficiently deep to permit the dredge, which draws 6 feet, to work, and of a width of from 250 feet to 300 feet, would be about \$45,000. In my opinion, the expenditure of this amount is advisable under the conditions which prevail at the locality, and I therefore recommend that this amount be appropriated for this purpose.

HONOLULU HARBOR (KALIHI CHANNEL), HAWAII—NEW PROJECT.

Report of the Chief of Engineers, printed in House Document 392, Sixty-fourth Congress, first session.

Kalihi Harbor is a shallow basin west of Honolulu Harbor and connected with it by a passage known as the "Reserved Channel." It has direct connection with the ocean through Kalihi Channel, an opening of considerable depth through the reef. The district officer states that the improvement of Kalihi Harbor is desired, not for the purpose of establishing a new and distinct port, but in order to provide increased harbor facilities for Honolulu. The existing space for berthing and turning vessels has become considerably congested, and additional deep-water area is needed to render the harbor safe and convenient for the maneuvering of vessels and for the establishment of additional wharves. In the report on survey the district officer submits a project for a channel 600 feet wide and 35 feet deep at mean lower low water, with a turning basin in Kapalama Basin. In the supplemental report of his successor, dated November 30, 1914, two plans are submitted for a modified project along lines suggested by the Board of Engineers for Rivers and Harbors. Each plan contemplates a channel 800 feet wide and 35 feet deep at mean lower low water, extending from Honolulu Harbor through the "Reserved Channel" to Kapalama Basin, the only essential difference being that project No. 2 provides for a wider entrance than project No. 1. The estimates are \$1,535,000 for project No. 1 and \$1,779,000 for project No. 2. The district officer states that a section only 1,000 feet in length should be immediately provided to meet present needs, leaving the remainder to be undertaken when required. The estimated cost of the proposed 1,000-foot section under project No. 1 is \$439,000, and under project No. 2, \$683,000. He recommends the adoption of project No. 2. The division engineer concurs in general with the views of the district officer.

The Board of Engineers for Rivers and Harbors concurs with the district officer and the division engineer regarding the need for increased facilities at this port, but favors the adoption of project No. 1, limiting the work for the present to the first 1,000 feet.

I concur in general with the views of the Board of Engineers for Rivers and Harbors, and therefore report that the improvement by the United States of Kalihi Harbor, Honolulu, Hawaii, is deemed advisable to the extent of providing a channel 800 feet wide and 35 feet deep at mean lower low water, extending 1,000 feet from Honolulu Harbor along the "Reserved Channel" toward the Kapalama Basin, in accordance with project No. 1, as shown on accompanying map, at an estimated cost of \$439,000 for construction and \$6,000 annually for maintenance. It is further recommended that authority be given for the purchase or construction of a Government-owned dredge, if suitable prices for the work can not be secured.

Under the advice of the engineer officer who came before the committee, the balance on hand of appropriation heretofore made for Honolulu Harbor is made available for this work.

HILO HARBOR, HAWAII.

Location and description.—East coast of island of Hawaii about 200 miles southeast from Honolulu and about 100 miles S. 41° E. from Kahului. Harbor protected by a breakwater. Open roadstead.

Existing project.—The improvement of this locality was authorized by the river and harbor act approved March 2, 1907, in accordance with a report (H. Doc. No. 407, 59th Cong., 2d sess.) which contemplated the construction, at an estimated cost of \$1,700,000, of a rubble-mound breakwater starting at a point near Cocoanut Island and extending along Blonde Reef for about 7,000 feet, for the purpose of protecting the harbor and anchorage of Hilo. The act provided, however, that, in the discretion of the Secretary of War, this plan might be modified as to the location and extent of the breakwater. Further modification of the improvement was authorized by the river and harbor act approved July 25, 1912, to provide for dredging to a depth of 35 feet at mean lower low water the entrance to Kuhio Bay, a tributary of Hilo Bay, at an estimated cost of \$76,000 (H. Doc. No. 417, 62d Cong., 2d sess.), it being understood, however, that this dredging should not increase the ultimate cost of the improvement. As finally located, the breakwater extends from a point on shore about 6,000 feet east of Cocoanut Island, so as to include Kuhio Bay in the protected area, and will be projected as far as can be done without increasing the original limit of cost of the work, an estimated distance of about 8,000 feet. The mean tidal range is 2.3 feet.

Condition at end of fiscal year.—The project is 49 per cent completed; 3,650 feet of breakwater has been completed and the shoals at the entrance to Kuhio Bay have been removed. The minimum depth in this bay at mean lower low water is now 33 feet. The total expenditures under the existing project to date have been \$863,841.81; all for new work.

Local cooperation.—Since the adoption of the project by the United States the territory has constructed a wharf at the head of Kuhio Bay at the following cost:

Dredging -----	\$47, 990. 00
Filling -----	64, 949. 00
Wharf construction-----	126, 828. 07
Wharf-shed construction-----	37, 755. 80
Conveyor system -----	1, 431. 82

Uncompleted contracts in force:

Wharf shed.....	\$14,942.41
Conveyor system.....	3,080.67
Shed.....	16,801.65
Maintenance and additions.....	6,151.75
Total.....	319,931.17

Effect of improvement.—A Territorial wharf has been completed at the head of Kuhio Bay, but is not being used, as it is claimed that currents or swells make it dangerous for vessels to lie at the wharf. An investigation is now being made to determine whether these currents exist and the effect that the completion of the breakwater will have. To date the breakwater has not affected the freight rates.

Proposed operations.—Work will be continued on the breakwater under the present contract in building the superstructure on the present completed substructure and in extending the breakwater as far as funds will permit. It is expected that all available funds will be expended during the fiscal year ending June 30, 1917. With the funds now asked for it is proposed to complete the breakwater in accordance with the approved project. It is recommended that \$150,000 of the \$524,000 required to complete the project be appropriated with a continuing-contract provision for the balance requested, or \$374,000.

Commercial statistics.—Sugar is the main export, while the imports are varied and consist of manufactured goods, foodstuffs, fuel, fertilizer, fodder, and building material, etc. The value of the commerce has increased from \$6,623,454 in 1906 to \$29,194,940 in 1915.

Comparative statement.

Calendar year.	Tons.	Value.
1913.....	434,102	\$22,263,041
1914.....	365,323	24,290,536
1915.....	428,417	29,194,940

Amount expended on all projects from Mar. 2, 1909, to June 30.

1916: New work.....	\$863,841.81
July 1, 1916, balance available.....	23,258.18
Amount (estimated) required to be appropriated for completion of existing project.....	524,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1918, for works of improvement.....	150,000.00

KAHULUI HARBOR, HAWAII.

Location and description.—North coast of island of Maui, about 110 miles by water S. 18° E. from Honolulu and about 100 miles by water N. 41° W. from Hilo. Dredged inlet in coral reef having a general width of 700 feet and an area of about 25 acres protected from the prevailing winds by a breakwater, and having a depth of 35 feet or over at mean lower low tide.

Existing project.—The existing project was adopted by the river and harbor act of June 25, 1910, in accordance with a report which provided for the following improvements:

- (a) Extend an existing breakwater to American Girl Rock.

(b) Dredge to a depth of 35 feet, mean lower low water, the area in the eastern part of the harbor to a line about 68 feet from and parallel to the bulkhead line.

(c) Dredge to a depth of 35 feet, mean lower low water, the area in the western part of the harbor, so as to give the harbor an average width of about 700 feet.

The cost of the project, estimated \$375,000 in 1910, was increased in 1912 to \$400,000; no estimate was submitted for maintenance. (See H. Doc. No. 593, 61st Cong., 2d sess.) The mean tidal range is 2.4 feet. The breakwater is a rubble mound.

The project has been modified by the river and harbor act of July 27, 1916, in which Congress appropriated \$100,000 and authorized \$150,000 additional for the construction of a west breakwater, as recommended in House Document No. 1330, Sixty-second Congress, third session.

Condition at the end of fiscal year.—The project has been completed, and the breakwater is in good condition, but the shoaling continues over the entire dredge area. The harbor now has a general width of 700 feet or an area of about 25 acres with a minimum depth of 35 feet at mean lower low tide and protected from the prevailing winds by a breakwater 2,200 feet long. Total expenditures under existing project to end of fiscal year have been \$390,291.90 for new work and \$26,974.95 for maintenance, a total of \$417,266.85. The project was completed during the fiscal year 1914.

Local cooperation.—The present projects was adopted subject to the following conditions, as set forth in the project document:

1. That the Kahului Railway Co. cede to the United States, free of cost, any rights it may have in the existing breakwater, and agree to make no claim for reimbursement for work done by it in constructing the breakwater or in improving the harbor.

2. That provision be made for a public street of proper width giving access to wharf.

The above conditions have been complied with.

For statement furnished by the Kahului Railway Co. showing work done by them, at a total cost of \$304,784.33, see page 1591 of the Annual Report for 1915.

Effect of improvement.—The loading of vessels is no longer interrupted by heavy seas, except during severe storms from the north. The effect on freight rates is not known.

Proposed operations.—It is proposed to expend the funds available June 30, 1916, together with the funds estimated for the fiscal year ending June 30, 1918, in redredging, under contract, such shoals as interfere with commerce and repairing the breakwater as exigencies arise, and to enter into a contract for the expenditure of \$100,000 appropriated July 27, 1916, together with the \$150,000 authorized by same act, in the construction of the west breakwater.

Commercial statistics.—Sugar is the principal export, while the imports are varied, consisting principally of foodstuffs, building material, fertilizers, live stock, etc. The usual limit of draft of boats using the harbor is 32 feet.

The inventoried valued of the commerce has increased from \$1,800,000 in 1908 to \$18,311,484 in 1915.

Comparative statement.

Calendar year.	Short tons.	Value.
1913.....	229,826	\$10,369,361
1914.....	213,667	13,255,317
1915.....	254,975	18,311,484

Amount expended on all projects from June 25, 1910, to June 30,

1916:

New work	\$390,291.90
Maintenance	26,974.95

Total	417,266.85
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Balance available for fiscal year ending June 30, 1917.....	112,734.65
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Amount of continuing-contract authorization, act of July 27, 1916.....	150,000.00
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Amount yet to be appropriated.....	150,000.00
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Amount (estimated) required to be appropriated for completion of existing project.....	150,000.00
---	------------

Amount that can be profitably expended in fiscal year ending June
30, 1918:

For works of improvement (sundry civil bill)	100,000.00
For maintenance of improvement.....	10,000.00

Total	110,000.00
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SAN JUAN HARBOR, P. R.

Location and description.—San Juan Harbor is on the north coast of Porto Rico and is the principal harbor of that island. It is 1,380 nautical miles south-southeast from New York, N. Y., and 1,000 nautical miles east-southeast from Key West, Fla. The harbor is a sheltered bay.

Existing project.—The existing project provides for rock excavation and dredging to obtain a channel 600 feet wide and 30 feet deep at mean low water at the entrance, thence a channel of the same depth and 500 feet wide along the main fairway to a point opposite the city of San Juan, a distance of $1\frac{1}{4}$ miles; dredging an area of 82.4 acres to a depth of 30 feet and one of 14.5 acres to a depth of 24 feet within the harbor proper opposite the city. The mean tidal variation is 1.1 feet. The report on which the project was based is published as House Document No. 914, Fifty-ninth Congress, first session. The project recommended therein was estimated to cost \$850,000 and from \$15,000 to \$30,000 per year for maintenance. The plan, however, was slightly modified by the river and harbor act approved March 2, 1907, in adopting the project, and as thus modified was estimated to cost \$757,500. The latest published map is contained in House Document No. 865, Sixty-third Congress, second session.

Condition at the end of fiscal year.—The project was completed in February, 1911. Subsequent shoaling has reduced the depth of the entrance channel from 30 to 28 feet, and this channel is now considered available at mean low water for vessels drawing 27 feet of water or less. Along the edges of the areas dredged in the interior harbor a slight and unimportant shoaling has occurred. The net results are that the entrance channel has been deepened from 25 to 28 feet and widened from 400 to 500 feet and the areas in the inner harbor avail-

able for deep-draft vessels have been materially increased. The expenditures under the existing project have been: For new work, \$747,684.28; for maintenance, \$35,341.78; total, \$783,026.06. As compared with the original estimate of cost, \$757,500 for new work, there was a saving of \$9,815.72.

Local cooperation.—No local cooperation has been required by law. An organization known as the San Juan Harbor Board has been provided by the local government. This board has undertaken the construction of a concrete bulkhead, 2,750 feet in length, and so built that vessels may lie alongside. This bulkhead will be provided with warehouses, railroad connections, and other facilities for handling cargoes, and will be open to all on equal terms. The total cost is estimated at \$371,000, which was provided by the local government. At the close of the fiscal year this work was completed, with the exception of warehouses and rail connections and 500 feet on the western end, which the harbor board has decided to omit. Three privately owned wharves are open to all comers on equal terms.

Effect of improvement.—The movement of larger steamers, which have increased in number, has been facilitated, additional steamboat lines have been established, and a reduction in freight rates, especially between the United States and the island, has been noted.

Proposed operations.—No operations are contemplated other than the supervision of structures in navigable waters in Porto Rico, minor surveys, and the care and maintenance of buildings and grounds assigned to the Engineer Department by proclamation of 1912. The entrance channel has shoaled in places from its dredged depth of 30 feet to 28 feet at mean low water and there has been a slight shoaling along the edges of the interior harbor. The deterioration at this time is not considered serious and no estimate for redredging is submitted. It is proposed to apply the balance of funds available in supervising structures in navigable waters in Porto Rico, surveys, etc. These funds will be expended by June 30, 1917.

It is proposed to apply the funds estimated as required for the fiscal year ending June 30, 1918, for supervision of structures in navigable waters in Porto Rico, surveys, etc., as follows:

Maintenance of office at San Juan, P. R., for salaries of employees, etc.,	
12 months, at \$800 per month	\$9,600
Contingencies	400
Total	10,000

Commercial statistics.—A careful comparison, covering several years, made between the amounts reported by the customs authorities for the whole island and those for San Juan Harbor alone indicates that the amount of commerce for San Juan Harbor averaged for the past 13 years about 55 per cent of that for the whole island. At this rate the value and tonnage of the commerce for San Juan Harbor was as follows:

Comparative statement.

Fiscal year.	Short tons.	Value.
1913.....	432,000	\$34,019,000
1914.....	543,000	43,730,252
1915.....	541,422	45,782,661

The principal items exported were sugar, tobacco, and fruit. The principal imports were foodstuffs, cotton goods, coal, lumber, machinery, etc.

Amount expended on all projects to June 30, 1916:

New work	\$747, 684. 28
Maintenance	35, 341. 78
Total	<u>783, 026. 06</u>
Balance available for fiscal year ending June 30, 1917	12, 161. 63
Amount that can be profitably expended in fiscal year ending June 30, 1918, for maintenance of improvement	10, 000. 00

EXAMINATIONS, SURVEYS, AND CONTINGENCIES OF RIVERS AND HARBORS.

For examinations, surveys, and contingencies, and for incidental repairs for rivers and harbors, for which there may be no special appropriation, an appropriation of \$350,000 should be made.

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RIVER AND HARBOR APPROPRIATION BILL.

JANUARY 13, 1917.—Committed to the Committee of the Whole House on the state of the Union and ordered to be printed.

4th Cong. Harbor
Mr. FREAR, from the Committee on Rivers and Harbors, submitted the following

17-26129 MINORITY VIEWS.

[To accompany H. R. 20097.]

This omnibus river and harbor bill starts in the House committee at \$38,192,839, in cash. Following invariable precedent, several million dollars will be added to the bill by the Senate so that its total when finally presented to the Executive for signature or veto, will reach all that the traffic will bear. The future obligations incurred by adoption of new projects reach approximately an additional \$47,000,000, or about \$76,000,000 in all, as presented to the House.

The first objection to the bill does not lie in its amount, although Congress has reason to fear the wrath to come from heavy tax burdens "wrung from the people." First and last it is a monument to "profligate waste," against which this administration is pledged (Baltimore, 1912, platform). Nowhere will be found evidence of wasteful methods in governmental affairs to be compared with the autocratic demand of Army engineers in 1917 for the following amounts from Congress.

Norfolk and Beaufort waterway, \$1,000,000; lower Missouri, \$1,000,000; upper Mississippi, \$2,000,000; central Mississippi, \$350,000; Mississippi Passes, \$2,000,000; Ohio canalization, \$5,000,000; lower Mississippi, \$6,000,000; Cumberland, \$977,000, reaching about \$18,000,000, for eight projects out of 300 or more contained in the bill, or about one-half of the entire fund asked for by the engineers to carry on the entire 300 projects in the bill. These items were slightly reduced by the committee, but the amounts named are those demanded by our waterway advisers.

Deducting from glittering commercial statistics, sand, timber, and coal, all actual river commerce reported on the eight projects probably does not equal that handled at the little harbor of Ashland, Wis., nor one-half that of Milwaukee, nor Chicago, nor one-quarter that of Boston, Buffalo, Cleveland, or many other harbors that could be

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named. All the actual commerce on these eight river projects will not reach 10 per cent of the waterway freight handled at the Superior Duluth Harbor, nor 5 per cent of New York City's waterway commerce. Compared with this \$18,000,000, demanded for engineers for eight comparatively insignificant commercial projects, the 1917 recommendations by Army engineers for actual waterway commerce of eight other old projects are as follows:

WATERWAYS THAT CARRY COMMERCE.

Ashland (6,534,410 tons), nothing; Milwaukee (8,119,875 tons), \$21,500; Chicago (10,227,830 tons), \$65,000; Buffalo (19,535,503 tons), nothing; Cleveland (12,631,442 tons), \$60,000; Superior-Duluth (40,494,672 tons), \$45,000; New York (100,000,000 tons), \$500,500; a total of about \$700,000 for a few actual waterways. Army engineers demand extravagant river appropriations and Congress grants their demands, if not in one House, then in the other.

The reason for deducting sand, coal, ferriage, timber, and duplications from absurd river reports furnished by the Chief of Engineers is because sand and gravel dug from the river and hauled from a half mile to 1 mile, together with ferriage statistics across the Mississippi, Missouri, and Ohio Rivers, in no way require deep channels, yet such items make up the major part of the elaborate commerce and of freight valuations reported by the Chief of Engineers on these rivers.

Twenty times more timber was annually floated down these streams 40 years ago, before Government waterway improvements were begun, and far more coal and legitimate waterway commerce was floated down the Ohio every year before the profligate expenditure of over \$90,000,000 was begun on the Ohio, of which nearly \$60,000,000 has been appropriated for that river without any return.

Government material dredged from the rivers including brush, rock, gravel, sand, coal, and provisions to keep the engineers fleet and thousands of employees busy, all figure ponderously in the Chief of Engineer's reports, although actual commerce has diminished on these rivers from 80% to 90% during the last 40 years.

QUADRUPLICATING COMMERCE STATISTICS.

Again it is impossible under present crude methods to prevent duplicating receipts and shipments of the same material and triplicating or quadruplicating the identical coal or other commerce which the Chief of Engineers first reports several times on the Monongahela or other headwater streams, and then reports at various points along the Ohio, and finally at Memphis, Vicksburg, and New Orleans. The reliability of statistics collected by such methods and from interested parties may well be questioned. Yet on such misleading statistics are estimates of commerce made by the Chief of Engineers, who thereupon demands an enormous annual appropriation in 1917, reaching \$18,000,000 for eight river projects in the pending bill—for projects that have received in past years approximately \$250,000,000 from the Government to maintain a commerce that has dwindled away until it is less than that handled by the single little harbor of Ashland, as stated, a harbor which receives nothing in the pending bill.

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After an expenditure of about \$23,000,000 on the Missouri River, the Chief of Engineers reported, page 2811, 1915 report, commercial statistics, 240,550 tons, of which 213,707 tons was sand, practically all, hauled one-half mile. The actual 1915 mercantile freight reached 19,377 tons, or less than 10 per cent of the total and less than is carried from Kansas City to St. Louis by rail in a single day—less than one-quarter of 1 per cent of Milwaukee Harbor's commerce. An analysis of Army engineer's freight statistics on these rivers appears in the Congressional Record, pages 1125 to 1150, of January 10, Sixty-fourth Congress. The 1916 bill carried \$1,500,000 for the lower Missouri and this pending bill carries \$1,000,000 more—not for commerce, but primarily for a 500,000-acre private land reclamation proposal the Government is financing—as shown by Congressional Record, January 13, 1916, pages 1128 to 1131, inclusive.

Col. Deakyne and Col. Townsend, two able Government engineers, recommended an abandonment of this private land reclamation project now being conducted on that river by the Government, but were overruled by the present Chief of Engineers. Large appropriations maintain dredgers, contractors, and hundreds of employees on this one project, all of whom are living off the Government Treasury without any apparent public benefit.

As stated at the outset, where else in all history of this or any other Government, can such waste and unbusinesslike methods be found? Petty dry creeks waste is bad enough, but insignificant when compared with the enormous sums of public money annually dumped into 58 inland waterways, which have been declared of dubious value by no less an authority than Col. Townsend, chief of the Mississippi River Commission, above referred to, but are recommended by the Chief of Engineers for enormous appropriations, totaling \$18,000,000 in 1917.

A \$76,000,000 BILL IN 1917.

With the usual percentage of waste, the old projects aggregate about \$29,225,000, that are all included for various amounts on the plea "we must continue them now that they have been adopted." There is added to that amount by this bill about \$9,000,000 cash for beginning 60 new projects that will carry future obligations on these new projects of approximately \$47,000,000 or \$76,275,000 in cash and obligations. These figures may not be exact but are approximate, and after increase by the Senate and future increases through under estimates of engineers the amount will probably reach far more than the figure stated. Small initial appropriations are started by this bill, the first bill in four years to contain new projects. These small first payments will start some sixty-odd new projects as stated under the \$10,000,000 cash limit as proposed, although future Congresses for many years to come will be compelled to carry and continue the remaining burden or else abandon many of these new projects in the same manner we are now trying to abandon scores of others that are maintained by a wasteful unbusinesslike system of dribbling appropriations.

In this time of financial stringency with the Government, what words can sufficiently condemn the new Oklawaha \$733,000 project with \$27,000 annual maintenance counting interest to serve 1,760 tons of 1915 "commerce" or the \$47,000 Kissimmee Creek new project, both

of which were stricken out of the 1914 bill by the Senate committee after they had passed the House that year? What profligate waste to buy up the bankrupt Chesapeake & Delaware Canal new project, whose stocks were worthless and bonds listed at 50 cents on the dollar before the Government recently became a possible purchaser. This canal is eventually a \$20,000,000 specter now pressing its demands in the pending bill with a \$1,300,000 initial appropriation for a nominal \$8,000,000 project, which initial payment, following precedent, is sure to be doubled in another branch of Congress. A new project for Raccoon Creek is side by side with the Scuppernong, the Newbegun, and the Congaree that again seek recognition. The Brazos, that has received \$2,946,250 for a small commerce near the mouth of the river, carries \$66,000 for the old project and \$150,000 more for another project, which when adopted by Congress will mean \$455,000 in addition to the three millions in round numbers already appropriated on other Brazos River projects, and all will eventually reach many more undetermined millions. Then we find a new project in the bill for \$4,500,000 for the Cumberland River above Nashville, with an initial appropriation in the bill of \$200,000, requiring over 20 years to complete. This is in addition to \$3,282,500 already appropriated for the upper river in order to produce in 1915 about 37,000 tons of commerce, excluding sand hauled 9 miles and timber products. On this same river, the Cumberland below Nashville, the Government has further appropriated in past years \$3,184,267, in addition to \$632,000 more contained in the pending bill to produce in 1915 just 16,374 tons of "commerce," excluding timber products and sand and gravel. All these amounts have been recommended by Army Engineers, and this bill carries \$837,000 for that river with its insignificant actual commerce. The Richmond, Cal., inner harbor \$428,000 project and others are equally wasteful and indefensible.

What could be said to justify this pending bill even if the Public Treasury was full to overflowing, and what possible defense can be offered for an omnibus bill which is over half waste so far as present or future commercial needs can be demonstrated? Yet by scattering 300 projects all over the country it has linked up locality interests so that the good is expected to carry along the bad. The vice of omnibus waterway bills has never been more noticeable and the time never more inexcusable.

What can be shown for \$900,000,000?

In Report 254, part —, Sixty-fourth Congress, first session, containing the views of a minority on H. R. 12193, the last river and harbor bill then pending before the House, it was stated:

One of the necessary activities of the Government relates to waterway improvement and apart from its economic importance is the responsibility accompanying an annual expenditure now reaching with sundry civil items approximately \$50,000,000.

Thus far the Federal Government has appropriated \$898,543,252 for river and harbor improvements (Report of Chief of Engineers, 1916, p. 33). Appropriations are made by annual omnibus bills containing projects good, bad, and indifferent. By this method good commercial projects, important emergency items, and needed waterway improvements are compelled to carry scores of projects and appropriations in one bill that could never pass Congress if offered in separate bills. Over 300 items, on the average, are contained in

every bill for waterway projects from Maine to California. Items of great commercial importance, like New York Harbor, for illustration, and Philadelphia Harbor are sandwiched in with projects like Absecon Inlet, Cold Spring Harbor, Trinity River, and other projects that come before Congress bearing the Army Engineer's approval, both as to their commercial importance and practicability from an engineering standpoint.

In Report 254, submitted on the last bill, which bill eventually passed Congress at about \$43,000,000, many items were criticized in detail in order to disclose the enormous waste that has resulted from the present method, or lack of method, with which the Government handles its waterway problem. This report will not attempt any detailed statement of objectionable items in the the pending bill, but will offer additional reasons to those presented in Report 254 why this omnibus waterway measure should be defeated.

RECENT BILLS THAT HAVE BEEN DEFEATED.

I quote from that report as follows, pages 1 and 2:

Cutting down the waste.

The 1914 rivers and harbors bill passed the House carrying in round numbers \$43,000,000. It was increased by the Senate committee to \$53,000,000, then defeated, and a substitute was passed for \$20,000,000.

The 1915 bill passed the House at \$34,000,000, and in like manner was increased by the Senate committee to \$38,000,000, then defeated, and a substitute passed for \$30,000,000.

The 1916 bill now carries \$39,608,410, and will be generously enlarged according to custom. It includes practically all the wasteful items contained in the defeated 1915 bill and some \$5,000,000 more than the last House bill. Already it reaches practically double the 1914 appropriation and is 30 per cent larger than the 1915 substitute, over one-third of which, according to high authority, could have been saved without affecting actual commerce. A substitute bill will be offered herewith and reasons given therefor.

The minority represents that the 1916 bill is made up of old projects, excepting one new project placed in the bill at the request of the President. Like its predecessors, the bill covers an enormous waste of public funds and is so economically bad and legislatively indefensible as to justly invite a storm of public criticism and ridicule. Whether new or old, a project found to be worthless ought to be abandoned or materially modified. Measured by this standard, not 1 appropriation in 3 contained in the bill would be favorably considered if presented in a separate bill—probably the proportion would be less than that stated. Not 1 project in 5 would have been presented originally if local contributions were required, as is the custom in other countries. (This 1916 bill eventually passed at \$42,886,000.)

Believing progress will be reached only by a frank statement of conditions and a sincere effort to present a constructive program for waterway improvements, this report will briefly offer facts that invite close scrutiny of many items in the bill and of waterway expenditures generally.

Government business ought not to invite license or waste. Business men are compelled to finance ventures out of business income—otherwise the venture fails. Not so the Government, which, drawing its revenues from indirect sources, may cover up waste, extravagance, and useless expenditures by a blanket declaration that public business can not be measured by private business methods. That policy can no longer conceal conditions or avoid responsibility when taxes are direct, because the same scrutiny then follows Federal expenses which ordinarily accompanies expenditures by private business, local municipalities, or sovereign State governments.

Direct taxes are here, and in presenting these dissenting views the minority believes a public responsibility compels it to place before the House a brief statement of waterway waste which reaches many millions of dollars annually.

In the presentation of this report it is necessary to consider—

First. What waterway improvements are for public use?

Second. What policy has governed the expenditure of \$850,000,000 on waterways since 1875, and how are we investing about \$50,000,000 annually that Congress appropriates for waterways?

Third. If waste exists, what is the cause and remedy?

The foregoing statement applies with equal force to the pending river and harbor bill now before the House.

In Report 254, part 2, is also a brief discussion on "what waterway improvements are for public use" and a statement from the National Waterway Commission relating to our national waterway policy together with extracts containing recommendations offered by the commission and facts showing the repudiation by Congress of the policy recommended.

The following is repeated in that connection:

LAND RECLAMATION IS NOT NAVIGATION.

The latest and only authoritative statement of a governmental waterway policy was presented to Congress in 1910 by the United States National Waterways Commission, which examined waterways in this country and Europe. Fresh from that investigation the commission laid down certain fundamental principles of government that are well to consider at this time. In the report the commission says (p. 1133):

It should always be borne in mind that the waterway improvements made by the Federal Government under the exercise of its authority should be restricted to navigation. Whenever bank protection or flood prevention or the clarification of water is the sole object of improvements the question presents little difficulty in its solution. Such projects are not a proper charge upon the Federal Treasury. * * * In many instances proposed improvements have as their main object the protection or benefit of private property. In such cases there is a distinct benefit conferred upon individuals or localities which is only of remote or very indirect benefit to the country as a whole. Lands subject to periodical overflow or lands of uncertain value because of the danger of erosion, when improved are multiplied many times in value, and there is a constant danger that such improvements will be advocated under the guise of river and harbor legislation framed to benefit navigation when the real object is the benefit which will accrue to individuals or localities. * * * The line should be carefully drawn between improvements which, in whole or in part, are for the protection or development of private property and those which are made in the sole interest of navigation.

THEO. E. BURTON.	WM. LORIMER.
J. H. GALLINGER.	D. S. ALEXANDER
S. H. PILES.	FREDK. C. STEVENS.
WM. ALDEN SMITH.	IRVING P. WANGER.
F. M. SIMMONS.	S. M. SPARKMAN.
JAMES P. CLARKE.	J. A. MOON.

Again it was pointed out that the Government receives

NO LOCAL CONTRIBUTIONS.

This report also calls attention to the fatuous, unbusinesslike policy of adopting hundreds of projects without making any provision for their completion, everywhere beginning new projects and continuing old ones with dribbling payments that have dragged the whole scheme of waterways into a hopeless, struggling mire of waste.

With rare exceptions no local contributions have been required in aid of waterway projects, thereby placing the entire system of financing and responsibility for failure upon the Government, and also affording a tempting method of getting public money for any purpose however distantly related to navigation. Needless to say that where Congress is the only body authorized to determine proper contributions, any action placing conditions on one project would invite similar conditions on projects in every other State and in every district where projects can be discovered. In a bill largely

devoted to local expenditures few conditions will ordinarily be imposed by Congress. It would destroy the attractiveness of getting something for nothing.

The scope of waterway expenditures has reached to private land reclamation projects, private water-power projects, bankrupt canals, and other propositions that have a very distant relation to navigation. How far we have drifted from the policy set forth by the national commission is a matter of public concern, because apparently the field of exploitation is without limit.

The speculative, promising commerce on rivers never materializes excepting occasionally on deep waterways.

THE "PROSPECTIVE" FREIGHT FALLACY.

No particular benefit to the public at large need be offered by the promoters of a Government river improvement. Nor is any commodity to be reduced in price to consumers, but promises of prospective benefits to competing manufacturers or the particular community are urged in justification of visionary schemes which, in the aggregate, involve the expenditure of hundreds of millions of dollars. To illustrate the folly of prospective business estimates, it may be stated that in territory tributary to the Arkansas River it was predicted a dozen years ago that 800,000,000 tons of coal tributary to the river would soon command a fleet of coal barges on the Arkansas. After spending \$3,592,402 on the Arkansas River we find 900,000 tons of coal were shipped by rail out of the territory adjacent to the river in 1914, but only 2,716 tons were floated 7 miles on the river last year. Although Army engineers have unanimously recommended an abandonment of this project, excepting for snagging, the same arguments are again urged on Congress that were presented a dozen years ago. Many illustrations of the failure of predictions are found throughout the engineers' reports.

On the Big Sandy River it was prophesied a dozen years ago that by canalizing the river a million tons of coal or more would be annually floated down that stream, whereas after spending \$1,626,125 upon the river only 12 tons of coal were floated 20 miles in 1913, and, strangely enough, that coal was for "Government use," floated at a cost of \$350 per ton.

On the Hennepin Canal, which has cost the Government \$7,597,781 for 33 locks, freight savings on grain were promised Iowa growers a dozen years ago of \$20,000,000 annually. For five years it has been used and only 5,868 tons of grain were floated in 1914 at a cost to the Government in interest and maintenance of over \$36 per ton. An actual loss in the insignificant grain shipments occurred from 1913 to 1914.

After spending \$23,000,000 on the Missouri River it is now predicted that \$14,100,000 will invite large grain shipments from Kansas City to St. Louis. Yet after squandering a score of millions on the river to date, not one ton of grain was shipped by water from Kansas City to St. Louis in 1912, 1913, or 1914. A total of 5,290 tons of grain was barged 115 miles in 1914, or slightly over one-quarter of the distance between the cities was averaged. This project was recommended for abandonment by the local engineer, but he was overruled by the board and Chief of Engineers.

The tale of prospective business and impossible realization is reflected on a great majority of inland waterways according to the official reports, and a complete answer to hypnotized waterway

meetings and gaudily prepared prospectuses of promoters will be found in an average loss of 90 per cent in river traffic within the past 40 years. Scores of concrete failures with practically no realizations are more convincing than all the pages of prospective statistics which have been used in the past to secure wasteful Government expenditures now reaching to enormous amounts.

WHEN MAY WATERWAYS BECOME PROFITABLE.

In report 254, part 2, Sixty-fourth Congress, a brief review was offered of European waterway improvements to which we are confidently pointed by waterway lobbyists and many sincere believers in present antiquated methods.

Facts taken from official statistics and able writers were then presented, all tending to show that apart from the Rhine and several other inland waterways of Europe, affected by conditions peculiarly local, many European experiments are of little value or, as stated in one case, commerce "is on the wane and altogether insufficient to make canal traffic profitable." Where foreign Governments have taken possession of railroads and control rates in favor of the waterway it is possible to compete with railway traffic, but in this country where we have no such ownership and only limited control, the demonstration of our complete failure requires no further proof than to show that \$150,000,000 spent on the Mississippi, \$60,000,000 on the Ohio, and \$23,000,000 on the Missouri, has been rewarded with a loss of presumably 80 per cent in actual commerce on these three rivers since the improvements were begun. These rivers are the greatest in the country, and after an expenditure of over \$200,000,000 we find that apart from possibly 10 per cent spent in open-channel work, the money has been largely thrown away. More serious, from a governmental business point of view, annual maintenance charges of several millions of dollars have been saddled onto taxpayers to maintain on these three rivers useless and extravagant "improvements."

In this country it is frequently the announced purpose of localities to rifle the Federal Treasury, not in the interests of navigation, but to compel railways to lower their rates. With State and Federal railroad commissions fully empowered to reduce excessive railway tariffs and with the President sending messages to Congress demanding that railway rates be increased, Congress is discovered in the absurd and anomalous position of appropriating many millions of dollars annually in an ineffective and indefensible attempt to reduce freight rates for some favored locality.

On this subject a portion of Report 254, pages 18 and 19, is submitted:

REDUCING RAILWAY RATES.

The minority represents that practically every river appropriation is urged upon Congress with a claim that the proposed waterway improvement will effect some reduction in railway freight rates at river or canal points. While waterways once exercised a potent influence in reducing railway freight rates, it is believed that the incentive and possibility of compelling a reduction in railway rates at river points no longer exists, except in isolated cases.

It is no part of this report to offer extended or technical reasons for self-evident truths, but it may be proper to say briefly that the Interstate Commerce Commission has been given power by law to regulate interstate commerce railway rates throughout

the country, and the right is constantly exercised. Practically every State has given to a State board the same power to regulate intrastate railway rates, or rates wholly within that State.

In determining railway rates it is well understood all commissions, including State and interstate, are governed by constitutional limitations against any reduction below a point sufficient to return reasonable earnings on the actual value of the physical property. The inevitable result follows that whenever rates on one branch of a railway system are reduced below the point of reasonable earnings some other part of that railway system must make up the deficiency by charging shippers in other localities proportionately increased rates.

While no absolutely equitable adjustment of railway tariffs can be effected, the principle stated is undisputed and the only purpose in restating it is to call attention to arguments uniformly urged upon Congress for improving visionary waterway propositions that will reduce railway freight rates.

ROBBING PETER TO PAY PAUL.

Probably not one waterway project in ten started during the past 10 years has effected or will effect any reduction in railway rates because, generally speaking, the projects so designed are chimerical and impracticable. If such rates were reduced at some particular river or canal point, not one taxpayer in a hundred within that State would be benefited, directly or indirectly, by a reduction of railway rates at that particular point. On the contrary, due to the necessity of adjusting rates on a reasonable earning basis, railway tariffs on the entire system and especially at inland points must be raised to meet any marked deficiency caused by reductions at river points. In this process of robbing Peter to pay Paul, the Government first compels the 99 residents at inland points to contribute direct or indirect taxes for dredging or canalizing a waterway for the one favored individual, and from which the 99 taxpayers ordinarily derive no direct benefit. If rates are thereafter reduced at particular river points, the 99 taxpayers who have been discriminated against under the process of a general adjustment of rates will be compelled to pay increased railway freight charges in order to make good the reduction at points along a waterway which they were taxed to construct. Can anything be more absurd or inequitable?

Promised benefits to the public at large through any prospective locality freight reductions require scrutiny. At committee hearings it is generally urged that some particular city or community wishes to secure a reduction in freight rates in order to place it upon the same commercial level with some other city more fortunately situated. Ignoring other special advantages that may be possessed by the complaining city, the Government is constantly importuned to give different municipalities better freight rates by pouring money into deserted or impossible waterways.

WASTEFUL WATERWAY PROJECTS.

This report does not assume to point out wasteful items whose numbers rival reputable commercial projects among the three hundred odd items found in the 1917 bill, and in the average omnibus waterway bill. To do so would be to extend a brief report to the limits of a large volume, but if time is afforded during the discussion of the bill, many of such projects will be referred to more in detail—appropriations that should be reduced in amount or projects abandoned—if commercial use is to be a determining factor.

Scores of projects in the bill have the stamp of approval of the Chief of Engineers which would not secure a dozen votes in either House if presented as independent measures. Insignificant projects that escape scrutiny through the omnibus bill, stand side by side with commercial projects of undoubted value. In the few committee meetings given over to public hearings and to consideration of the amount to be appropriated and general character of the bill, no careful examination can be had of the value of individual items, although the reason for dividing up geographically thousands of projects heretofore approved by engineers, so that approximately 300 items are found in every bill, is not hard to find. By a coin-

cidence this task seems mathematically well adjusted by the annual recommendations of engineers in conjunction with the bills regularly recommended for passage.

NEW PROJECTS AND OLD.

New projects of great commercial importance are withheld or inserted as a whole, with others of insignificant value, only after the committee determines what policy is to be pursued in the preparation of the bill. The evidence of this fact is found in the last bill containing new projects (1914), where an \$18,700,000 Alabama water-power project at Muscle Shoals, the \$733,000 Oklawaha and \$47,000 Kissimmee and the \$8,000,000 to \$20,000,000 Chesapeake & Delaware Canal projects were crowded into that bill with initial appropriations, side by side with great commerce bearing projects. Only one new project has been adopted during the past four years and that for New York Harbor was secured after a strong letter from the President and a vigorous fight on the floor. The insertion of one new project challenges the insertion of others, whether of great or little importance, although no question is ordinarily raised to appropriations for practically every old project, good, worthless, or indifferent, carrying future expenditures of hundreds of millions of dollars, and at practically the amount annually recommended by the Chief of Engineers. This is not due to confidence in his judgment, but because we are unable to cut loose from a practice supported by locality pressure and because we have exalted the engineer to the position of final arbiter.

WHY INSERT \$76,000,000 IN NEW PROJECTS?

On January 5 the committee, by a majority vote of those present, decided to insert new projects in the 1917 bill. One hundred and sixty new projects, aggregating approximately \$150,000,000, were placed before the committee from which to select projects of most pressing commercial importance. The 160 engineer's reports on all proposed new projects awaiting action, presumably comprise 5,000 pages of opinions and data, intended for congressional consideration.

After five legislative days consideration of these new projects by the committee, together with the transaction of other important business, including hearings pertaining to old projects and new, and a proposed resolution, the pending bill was reported out of committee on January 11. This information is all a matter of public knowledge, although the method of selection and distribution of 60 new projects, aggregating \$47,050,112, appearing in the 1917 bill is improper to discuss or comment upon. These new projects carry \$8,967,839 in initial cash appropriations as originally stated, but the real liability is contained in the total adopted.

No body of experts, it can be fairly said, although giving undivided attention to the subject, could intelligently examine one quarter of the 160 reports in five days and make a wise selection of the most important projects. Further, no body of experts could examine and fairly determine the commercial value of one quarter of the new projects placed in the bill within the five days mentioned. With Army engineers' reports recommending all projects as of equal commercial importance, without needed public hearings or personal knowledge

of the facts, the committee and Congress under present hodgepodge methods, makes such selections as it sees fit, based on arguments or information which may be most convincing to the individual members.

It is submitted that the insertion of new projects in this manner does not permit further comment in this report, although a brief consideration of value, or lack of value, ought to be placed before the House when the bill is under discussion.

WHY NOT DROP WASTEFUL OLD PROJECTS?

What argument can move Army engineers and Congress to eliminate or temporarily sidetrack Absecon Inlet, or Cold Spring Inlet, or Raccoon Creek, or Shallowbag Bay, or Scuppernong Creek, or the Wateree or Congaree, or the Little Peedee, or the Big Peedee, or the Kissimmee, or the Anclote, or scores of similar projects, including two rivers named "Mud," contained in the average omnibus bill under various titles? What influence would be potent in securing elimination of the Trinity or the Brazos or the Red or the Arkansas, every one of which has cost the Government approximately from \$2,000,000 upward, without producing any appreciable commerce, and what can drive from these bills a grist of bayous and deserted canals whose principal commerce appears to be that furnished by Government dredges and Government private contractors.

In fact, reaching over to the Mississippi Valley, what pressure will compel the Chief Engineer and Congress to hold up 58 waterway projects in that valley, from the Missouri \$20,000,000 new project to the Big Sandy, which costs the Government \$300 per ton for a waterway, all of which Col. Townsend, chairman of the Mississippi River Commission, says should remain in statu quo until one single river or creek on which the Government is annually squandering money, develops adequate commercial results, and yet these 58 waterways receive approximately one-half of the total amount contained in the pending bill.

With the hopelessness of the present system confronting us, whether it relates to large or small projects, from the Mississippi down to the Little Peedee, the only possibility of reducing profligate waste and securing value received from waterway expenditures is by changing present methods of approval and recommendations, and until that time comes to defeat omnibus bill appropriations.

OMNIBUS BILLS COVER ENORMOUS WASTE.

For years Congress has been passing omnibus bills that have grown in size, extravagance, and possibilities with succeeding Congresses.

Legislative responsibility is shirked by a bill containing good, questionable, and bad purposes and projects.

If Congress had been called upon to vote \$60,000,000 for the Ohio canalization project in addition to over \$20,000,000 previously spent on that river, or to vote \$20,000,000 on the Missouri River 500,000-acre private-land reclamation project, in addition to \$15,000,000 previously spent on that river, or \$1,500,000 for the last-named project last year and \$1,000,000 more this year, how many votes would have been mustered for either of these projects standing alone? The same illustration governs over half the projects approved

by Army engineers, which total hundreds of millions of dollars out of the \$900,000,000 heretofore appropriated by the Government for waterways. The flood-control bill, profiting by loose legislative methods invited by omnibus bills, has this session placed an initial appropriation or authorization of \$45,000,000 for the lower Mississippi 16,000,000-acre private-land reclamation project. Although Army engineers have testified the ultimate cost to the Government will exceed \$200,000,000, others familiar with the work declare it will reach many times \$200,000,000 during the next few years and ultimately fail in its flood and reclamation promises. Fish hatcheries from Florida to California now serve to aid the passage of questionable fish-hatchery omnibus bills for the first time on record.

The public-building omnibus bill is of the same general character, wasteful, extravagant, and legislatively inexcusable, smaller in its waste than waterways and land-reclamation bills, but, like infantile paralysis, equally objectionable to healthy public business. Of all these bills the omnibus waterway bill is the pioneer and we will not be able to uproot a bad system until we repudiate such legislative methods and defeat such bills.

RAILROAD INFLUENCES IN LEGISLATION.

Possibly no better evidence of a discredited cause, supported largely by interested waterway lobbyists, can be afforded than suggestions that efforts to stay the flood of waterway waste in public appropriations is instigated by railroad influences. Insinuations from Members of both Houses of Congress are repeatedly offered on occasions when waterway lobbies hold their annual meetings in this city.

At such lobby meetings the Chief of Engineers frequently gives his valued opinion of the pressing needs of waterway improvements which he is superintending, so that uninformed men present at such meetings are impressed with the necessity for renewed pressure on Congress to pass these criminally wasteful bills.

Resolutions have been repeatedly introduced in the House by this minority member of the Rivers and Harbors Committee demanding an investigation of the charges of railroad influences. None of the statesmen who appear before waterway lobbies has seconded this effort to ascertain the truth or falsity of such charges, but, on the contrary, the resolutions of inquiry uniformly have been buried in committees.

Every opponent of waterway extravagance would welcome such investigation. Why, then, are reckless charges made by Members of Congress before irresponsible lobbies that have no means of ascertaining the facts?

No evidence has been offered in Congress tending to support the charge that railway influences are interested in an effort to stop profligate waterway waste. On the contrary, abundant testimony has been offered by this minority member of the Rivers and Harbors Committee tending to show that certain railway companies have contributed to the support of waterway lobbies which regularly urge the passage of enormous omnibus waterway bills. Such proof has been placed in the Record repeatedly or would be submitted with this report.

DREDGING CONTRACTS AND ALLOTMENTS.

Specific evidence also has been placed in the Record, and resolutions of investigation introduced, concerning dredging companies and their activities with waterway lobbies and secret methods of allotting Government contracts. These resolutions affecting any secret activities of railways, dredging companies, or other interests in connection with waterway bills before Congress are of public importance and should be pressed for consideration by those in either House possessing sufficient influence to ascertain the facts.

Evidence of apparent extravagance or fraud in the present method of letting contracts is offered in this connection. On October 8, 1914, this minority member of the committee placed before the House what purported to be a copy of a secret agreement among dredgers, wherein it appeared that a dredging board representing the various dredgers was engaged in fixing prices on Government contracts and allotting work to the members of the association, together with contributions and active lobbying to secure the passage of omnibus waterway bills.

Last session of the Sixty-fourth Congress the river and harbor bill carried a provision attempting to prevent excessive profits by private dredgers working for the Government. An examination of the Chief of Engineers' Report for 1916 shows that one particular dredging company was awarded all contracts on many different projects in the Baltimore district at one fixed price of 26½ cents per yard. One project alone was excepted, and in that one contract let to another dredging company the contract rate for dredging apparently the same kind of material, sand and mud, was let at 7.9 cents per yard, or less than one third of the favored company's many contracts (pp. 2109 to 2136. Report 1916).

No comparative Government cost is offered and no Government plant operated in the district.

Other contracts let to this same first-mentioned company on the Delaware River aggregated approximately \$450,000, according to the 1916 report, and were let at rates of 14.7 and 24.9 cents per yard, respectively, whereas three other contracts with two other companies on the Delaware project averaged about 9 cents per yard.

By a coincidence the same first-mentioned company has an exclusive contract on the James River, reaching 57 cents per yard for ordinary dredging, \$9.30 per yard for hard rock, and 17 cents per cubic foot for removing snags and stumps from a stream that was recommended for discontinuance by engineers, but was put in the bill by Congress over that protest. Did the dredging company influence that result? Why is the Government paying \$9.30 per yard for navigation on the James?

Another contract at Baltimore Harbor at a lower dredging rate, held by this same company, is one of numerous exclusive contracts which are at least open to inquiry when it is understood that this company, possessing so many exclusive Government contracts, some at questionably high prices, has for its president the same gentleman whose name purports to have been signed as president of the board of directors of the Atlantic and Gulf Coast Dredge Owners' Association, which association in past years secretly allotted Government contracts to its various members.

WHY NOT KNOW THE FACTS?

Whether secret agreements for allotment of contracts resulted in the prices quoted, and in exclusive Government contracts reaching presumably from a half million to a million dollars annually to this one company, can only be ascertained by a public investigation of the dredge owners' activities in connection with river and harbor legislation and subsequent allotment of contracts.

It is submitted that facts appearing in the Chief of Engineers' Report indicate that if contracts are let by competition, a dearth of genuine competitors appears to exist and that dearth may account for the apparent holdup disclosed by prices at which these contracts were made on behalf of the Government. What shall be said in defense of 60 new projects in this bill in addition to a thousand old ones maintained by dredging, when holdup prices are now employed by reason of lack of genuine private competition?

OTHER DREDGING CONTRACTS.

The Chief of Engineers' Report for 1915, page 486, states that on the Norfolk and Beaufort waterway project, which expended \$647,153 of Government funds in 1914, "the average cost of 1914 work with Government plant was .043 per cubic yard. * * * The average contract price was .0752 per cubic yard." Thereupon Congress appropriated another million dollars in 1916 for this wasteful project, but with a legal condition that private contracts thereafter should not exceed 25 per cent more than the cost of work by the Government. This amendment to the law covering all contracts let by the Chief of Engineers on the part of the Government was opposed by the present Chief of Engineers, who, in a letter addressed to the chairman of the Rivers and Harbors Committee, says, "It is believed that contracts (are now let) at prices which are as low as will permit the contractors to maintain their plant and make any profit whatever." (Record, p. 6759, Apr. 11, 1916.)

The apparent solicitude for private dredgers did not deter Congress from reducing, by law, dredging contract profits from 80 per cent over Government cost to 25 per cent profit by amendment to the 1916 bill. Congress can only pass laws. It does not administer.

WHAT IS THE PROFIT NOW?

In 1915 \$457,979.87 was spent by the engineers on this same questionable project. In 1916, \$1,000,000 more was appropriated by Congress for this project under the advice of the Chief of Engineers.

On page 2178, report 1916, it appears that private contractors were given new contracts at 14 cents per yard whereas former contracts by the same company were made at 0.0948 cents and 0.069 cents, respectively, and by a coincidence the 1916 report increases the average cost of dredging by the Government to over 11 cents and by private contract average in 1915 to about 10 cents per yard. This information furnished the foundation for definite important legislation restricting rates of dredging contracts by law. Why did the Government plant cost in 1915 equal private contract? What was the comparative cost and what was the method of ascertainment?

Another interesting fact is presented concerning dredging contracts on the \$5,400,000 Norfolk-Beaufort waterway project along the creeks, sounds, and marshes of North Carolina. On page 524, report 1916, the Chief of Engineers recommends another million dollars for this project in addition to \$1,035,304 on hand available for 1917. His recommendation urges that \$720,000 of the \$1,035,304, on hand will be used for private dredging in 1917, or four times the amount needed for Government dredges and on a project where the Chief of Engineers last year protested that a 25 per cent limitation of profit on private contracts was impracticable, on which proposition he was overruled by Congress. This canal project reports a nominal actual commerce in 1915, but on page 525 of the 1916 report, Congress is advised by the Chief of Engineers, that an additional million dollars will be needed and it is so provided in the pending bill, to include \$685,000 more for private dredging contracts on this same canal. In other words protests that we can not safely limit profits are followed by enormous contracts supposedly under a 25 per cent limitation, while the Government dredging in 1918 is estimated at \$60,000 or less than 10 per cent of that used for private contracts (1916 report, p. 525).

“ADMINISTRATIVE” IN ONE PROJECT, REACHES \$235,304.

It is also interesting to note that of the \$2,035,304, on hand or included in the pending bill, on this one project, \$235,304.85 is for engineering supervision and administration. Who supervises the engineers' estimates or enormous expenditures throughout the country for “supervision”? That extravagant amount of money was recommended by the Chief of Engineers for a project on which he reports 80,878 tons of commerce in 1915, after excluding timber products, and of that 80,878 tons of “commerce,” just 32,008 tons was cheap coal. Again it is noted the engineers' report does not state what proportion of the insignificant freight was used to furnish supplies to contractors and to maintain the fleet of Government and private dredgers working along the canal. The report does state a significant fact when it discloses that \$154,500 is set apart (p. 525) to purchase a right of way and dumping grounds along a portion of this Norfolk and Beaufort Canal. The local engineer advised the Rivers and Harbors Committee that about 800 acres of land would be required for this right of way and additional land would be needed for “dumping grounds” although the engineer stated much of the land was uncultivated marsh land that would actually be improved by the mud dumped upon it.

The land generally is marshy and uncultivated and excepting a small portion, is estimated by him at \$10 an acre, and yet the Chief of Engineers recommends that Congress appropriate \$154,500 for 800 acres of right of way along the marshes of Albemarle Sound, together with such land as may be required for dumping ground, and all for a 1915 commerce of 81,354 tons that included 32,008 tons of coal. It is confidently predicted that the commerce “which fell away about 40 per cent during the last two years (p. 527, 1916 report), will some day grow to much larger proportions.

In this connection it is worth recalling that 40,494,672 tons of commerce at the Superior-Duluth Harbor receives \$45,000 in the

pending bill, while New York Harbor's 100,000,000-ton commerce is provided with \$40,000 for Ambrose Channel and \$210,500 for Hudson River Channel. Apart from these amounts the Harlem River, carrying 15,000,000 tons of commerce, gets \$250,000, or, in other words, the Chief of Engineers asks and secures from Congress in the pending bill, about twice as much for this wasteful North Carolina Canal project compared to that given New York Harbor's existing projects and to the Harlem River combined. New York's waterway handles over 1,000 tons for every ton on the Norfolk-Beaufort Canal, coal included.

IRRESPONSIBILITY ACCOMPANYING UNBRIDLED POWER.

The brief consideration of the Norfolk and Beaufort waterway here offered is not intended to present other objections to this wasteful project which may properly be urged and of which Senator Burton once said in debate on this same project:

No removal of tolls on canals, no enlargement from 9 or 10 feet to 12 feet in depth, no expenditure of \$5,400,000 is ever going to bring back what has been lost to those channels. It is a chimera; it is a waste of public money to attempt it.

In this report no attempt is made to discuss individual projects but rather to set forth evidences of the fundamental weakness of the present wasteful extravagant system. The Norfolk and Beaufort illustration is offered to briefly afford light on the judgment exercised by Army engineers and particularly of that feature relating to the letting of many millions of dollars annually in private dredging contracts, entered into by the Government, from Maine to California.

The present system, or lack of system, removes responsibility for expenditures, encourages waste and extravagance, and on the part of the Board of Engineers has resulted in a constant assumption of more power, until that board has become an autocracy among many boards in Washington which are constantly seeking to enlarge their powers and influence. The engineers voice is law because he determines both projects and appropriations, expending many millions annually without question or supervision.

Notwithstanding the multifarious duties placed on the shoulders of the Engineering Corps by Congress, 69 officers out of 197 in this country are engaged in whole or in part with river and harbor work, while out of the 1916 annual report of 3,796 pages, 3,766 pages, or 99 per cent, is devoted to thousands of rivers, creeks, canals, and harbors which these officers have surveyed, angled, and triangulated and finally recommended to Congress as commercial projects worthy of Government improvement.

During the discussion of the last military bill in the House, the chairman of that committee (Mr. Hay), complained in debate of the assignment of Army engineers to surveys and work on waterway projects when their services were needed for legitimate military work. Doubtless 90 per cent of those so employed would welcome relief from present assignments and it is no reflection upon the rank and file of Army engineers who individually and collectively are able men of high character, to say that many of them do not approve nor agree with those who are possessed with power and authority to expend and largely waste, appropriations approximating from forty to fifty million dollars annually, without restriction or responsibility. It

must be kept in mind that millions of dollars additional are appropriated by Congress for waterways through other acts, including sundry civil bills.

ONE REASON FOR EXTRAVAGANCE.

In advocating a change in the present strongly entrenched omnibus waterway appropriations, it is necessary to offer specific facts affecting the attitude of Army engineers whose approval is set forth as a defense for the adoption of projects.

Where will the responsibility rest for projects like the upper Mississippi 700-mile project, which, after an expenditure of \$28,000,000, brings an estimate from the Chief of Engineers in 1916 of \$2,000,000 for next year for an actual commerce which cost the Government approximately \$15 a ton in 1915; or for the Ohio River, which cost the Government for actual commerce, excluding coal, approximately \$40 per ton as nearly as can be determined; or for the Muscle Shoals, recommended by the present Chief of Engineers, on the Tennessee, which is a water-power project, to cost \$18,700,000, which the Government is to advance and pay, in large part, for a traffic that will probably cost the Government \$150 per ton? At this point I submit a statement of estimates of cost to the Government for such commerce on several large inland waterways, taken from Report No. 254, submitted by this minority member against the last river and harbor bill:

The cost to the Government for furnishing a waterway for inland commerce, per ton, is not definitely settled as to method of computation and only approximate results can be reached because the amount properly chargeable to investment interests is variously estimated, although annual maintenance is sure and certain. Excluding floatable timber and sand usually hauled short distances, the following estimates have been made on the several rivers and canals noted:

	Per ton.		Per ton.
Ohio River (excluding coal, \$40 per ton).....	\$3. 00	Missouri.....	\$40. 00
Ouachita.....	8. 00	Muscle Shoals (Tennessee).....	40. 00
Warrior and Tombigbee.....	12. 00	Aransas Pass Canal.....	80. 00
Upper Mississippi.....	12. 00	Brazos.....	80. 00
Lower Mississippi.....	35. 00	Red.....	100. 00
Arkansas.....	20. 00	Muscle Shoals (proposed).....	150. 00
Hennepin.....	36. 75	Big Sandy, Ky.....	350. 00

A further statement taken from the same report is also submitted preliminary to a discussion of the responsibility for manifest waste incurred.

WATERWAYS COST PER MILE.

Students of transportation in determining the economic value of railways or waterways first ascertain the cost per mile of the system. Railroads with terminals have frequently increased in value 50 per cent within the past decade and the capacity and earning power has been proportionately increased, subject to rate limitations made by law. The same basis of computation applied to inland waterways discloses Government investments have not increased in value nor has use increased with improvement. On the contrary, after spending in round numbers \$230,000,000 on our three greatest rivers, waterway traffic has rapidly decreased and on the Mississippi reaches less than 10 per cent of the waterway traffic existing 40 years ago.

Applying the foregoing valuation method, \$230,000,000 would probably have built and equipped through the same section of country, at the time of the expenditures, between 6,000 and 8,000 miles of Government railway, or under present conditions

4,000 or 5,000 miles, with an earning power on the investment that would be of immeasurable value to the country through greatly reduced charges. This is particularly true if the system was used for carrying freight instead of passenger, and other high-class traffic. The illustration is not offered in support of Government ownership of railways, but to present familiar comparisons and it is interesting to note that in round numbers the following estimate of expenditures per mile have been made by the Government on these three waterways:

	Per mile.
Lower Mississippi, 1,000 miles, at.....	\$100, 000
Ohio River to Missouri River, 200 miles, at.....	86, 000
Upper Mississippi, 600 miles, at.....	40, 000
Ohio River, 1,000 miles, at.....	60, 000
Lower Missouri, 400 miles, at.....	40, 000
Government and State canal investments are proportionately wasteful.	
Hennepin, 60 miles, at.....	126, 000
Muscle Shoals, 26 miles, at.....	175, 000
Muscle Shoals, proposed, 26 miles, at.....	560, 000
Chesapeake & Delaware Canal, proposed, 13 miles, at.....	1, 530, 000

The above river and canal projects are from waterways that float an insignificant commerce compared with the investment. Can any condemnation of our wasteful, purposeless waterway policy compare with a brief statement of expenditures past, present, and prospective?

WHO IS RESPONSIBLE FOR THIS WASTE?

All of these projects, with rare exceptions, are based upon the recommendations of Army engineers and are being maintained or improved at the present time by the Government under the advice of these same officials. Col. McD. Townsend, president of the Mississippi River Commission, registered an emphatic protest last year that should be respected.

After a half century of strenuous inland waterway improvements and the expenditure of one hundred and fifty millions on the Mississippi River and double that amount in the Mississippi and Ohio River Valleys the futility of further waste is squarely placed before us by a speech of Col. C. McD. Townsend, chairman of the Mississippi River Commission and one of the most experienced Army engineers in Government service. (Cong. Rec., Dec. 11, 1915.) He says:

"St. Louis for the past 50 years has been the principal origin or terminus of the traffic on our western rivers, and its records summarize their tendencies. Its river commerce attained its maximum of 2,120,000 tons in 1880, and has since steadily declined to 153,000 tons in 1914. In contrast it may be stated that the commerce at Sault Ste. Marie, the outlet to Lake Superior, in 1880 was 1,300,000 tons, and attained a maximum of 79,000,000 tons in 1913. The commerce of New York Harbor exceeds 125,000,000 tons. * * * Specifically, the writer would not abandon any navigable stream in the Mississippi Valley that has been partially improved, but would leave 58 of them in their statu quo, confining operations to snagging and the maintenance of existing works and would concentrate appropriations on opening up a channel of the capacity of that existing on the lower and middle Mississippi to Chicago and Pittsburgh. * * *

"If the facilities thus afforded by the Government are utilized, the upper Mississippi and the Missouri Rivers should then receive attention."

We are asked to halt "improvements" on 58 river projects by Col. Townsend.

Again, no more impressive warning can be found than in the minority report of the Sixty-third Congress by Senator Burton (S. Rept. 599, pt. 2), wherein he says, page 11:

The waste which has been incurred in the canalization of rivers by the expensive system of locks and dams has been even worse than in improvement of open-channel rivers, the navigation of which has dwindled to such small proportions.

The foregoing is offered from men of recognized standing to show where we have been led by the extravagance and mistakes of judg-

ment of Army engineers. Many illustrations could be presented of specific wasteful projects. One hundred and fifty foot locks and dams for the Tennessee River at Muscle Shoals are recommended for the improvement of navigation.

After spending \$4,555,000 to encourage navigation on this little 26-mile canal the Engineer's Report for 1916, page 1186, shows the total "commerce" carried in three years aggregated 22,454 tons, and on page 1185 appears a recommendation for advancing \$18,700,000 more for this same insignificant canal to help navigation and develop power. This is the site owned by the Alabama Power Co., which has been actively urging such legislation for several years.

On such recommendations and \$20,000,000 for the Missouri River and \$60,000,000 for the Ohio and a balance sheet disclosing appropriations of practically \$900,000,000 for rivers and harbors, with an insignificant actual commerce on all inland waterways, apart from deep-water channels, we are asked to continue the present system of unlimited control possessed by Army engineers who now exercise all the prerogatives once held by Congress. Yet we are told these rights can not be surrendered to an intelligent responsible board of high-class men, whose power would only extend to investigations and recommendations, leaving Congress to appropriate all money.

HOW PROJECTS ARE STARTED.

It may be profitable to briefly discuss the present means of securing waterway projects in such bills provided by Congress.

First, the locality, generally influenced by interested parties, urges a survey by Army engineers. Hundreds of thousands of dollars are appropriated for new surveys in every bill. Surveys to make navigable mud inlets and crooked creeks where a proposed factory may be located or to serve some local industry. Few worthy projects after thousands of surveys are now unprovided, and it is noteworthy that while the Government digs many channels up to private concerns for private use it would not think of constructing a railway sidetrack at Government expense anywhere, and for good reason. Waterway projects are regularly urged wherein innocent appearing public projects frequently develop into private propositions, while a simple increase of depth in an existing project of 5 feet, may involve many millions of dollars, depending upon the character and length of the project.

ENGINEERS' SURVEYS AVERAGE ONE-THIRD APPROVALS.

It is estimated that engineers' approvals of projects run about one-third of all those surveyed, so that in a bill carrying 150 surveys 50 new projects may be found knocking at the door when the next bill is before Congress. Engineers are the supreme authority on all matters of commercial importance and requiring engineering skill. After the project has been approved, and a great mass of new projects aggregating \$150,000,000 awaiting appropriations are already in this class, the locality next brings pressure upon Congress to insert their project in the annual bill. By a singular situation

the Chief of Engineers refuses to say which project is the most important or the need most imperative, so that the \$18,700,000 power project of the Alabama Power Co. at Muscle Shoals and the Richmond Harbor real estate project out in California, reaching \$428,000, are both struggling for recognition in every bill side by side with a new \$39,770 engineer's recommendation for Racoon Creek and a new \$733,000 project for the Oklawaha hyacinth-covered river, down in Florida. Scuppernong Creek in North Carolina has a new project that was placed with the Oklawaha in the 1914 bill, together with the \$18,700,000 Muscle Shoals power project, but that bill was defeated, and these projects again seek congressional aid. Public necessity, commercial need, or Government emergency seem to have no part in determining commercial importance of projects or their priority of claim, and so Smith Creek, Md., and Deep Creek, Fla., the Kissimmee and Congaree are struggling to get new project appropriations from Congress side by side with Norfolk and Boston Harbors. Congress determines the relative importance by placing them in the omnibus bill, so, as stated, in 1914 we found the Muscle Shoals \$18,700,000 water power initial item and the Oklawaha \$733,000 project in that bill, together with the Kissimmee \$47,000 project, for a stream dry or semidry eight months in the year. The water-power project is omitted in the pending bill, but a score or more of other wasteful projects are cared for.

This is the situation confronting Congress under the present system. No intelligent means of determination of the comparative importance now exists. Where can such ignorance and waste be found to equal this method of legislation?

GOVERNMENT "EXPERTS" ARE BUSINESS NOVICES.

Due to unlimited power placed in his hands, the Chief of Engineers' supreme power has brought forth another peculiar situation to which I have briefly referred. It is no reflection upon Army Engineers to say that without business training, commercial experience, or official responsibility, apart from that affecting individual honesty, which has not been questioned, profligate waste and useless expenditures of public money have followed every omnibus bill.

A brief examination of projects on which hundreds of millions have been expended makes evident this unwelcome fact.

Col. Townsend's recommendation that Congress call a halt on 58 inland waterway projects which have cost the Government over \$250,000,000 is only one of the warning notes thus far sounded. Army Engineers ask for appropriations for all these projects and directly or indirectly the Government is maintaining them, from the hopeless Trinity River, Arkansas River, and Red River to the Hennepin Canal, which last-named project cost the Government approximately \$50 per ton for all of its actual commerce last year.

Every year we tax the people of the United States for such profligate waste without any hope of relief under the present system. Misleading commerce statistics, including ferriage across rivers, logs and timber, sand hauled by owners a half mile or more, Government material, and other "freight," are found on analysis to make up

practically all of the "commerce" floated on some streams that receive enormous appropriations.

For a more detailed discussion of separate projects, attention is invited to report 254, part 2, this Congress, heretofore referred to, and a brief extract is quoted to show that the waste is not confined to inland rivers.

WASTEFUL OTHER PROJECTS.

An investigation of waterway waste need not be confined to rivers and canals.

The minority calls attention to the fact that Sandy Bay Harbor, Mass., a \$6,904,952 project on which \$1,883,643 has been expended, was originally started in the face of an adverse report by Army Engineers, who have again within the past six months recommended its abandonment. Local interests protest against its abandonment. Local interests generally do.

The Jamaica Bay Long Island Harbor, recommended by our Engineers, is a \$7,430,000 project, on which \$165,011 has been spent, is a project which has excited the condemnation of those familiar with the facts, and has been practically abandoned. A balance of \$700,000 is available for use.

Cold Spring (N. J.) Inlet has taken nearly a million dollars for developing a proposition as closely associated with a private real estate venture as Jamaica Bay. The 1916 bill carries \$40,000 for this item.

Lookout Harbor, reaching \$3,526,600, was started against an adverse report of Army Engineers, who were then apparently directed by Congress to state which of two questionable locations was least objectionable. From Matawan Bay, N. J., to Richmond's inner harbor, in California, will be found other bays and harbors that, in diplomatic phrase, may be classed as emphatically questionable.

Col. Kingman said of Lookout Harbor in 1910, "it is dear at any price," and advocated the rejection of both locations. He was overruled by Gen. Bixby. (H. Doc. No. 528, 62d Cong.)

ABANDONED CANALS.

Canals are of little commercial value in this day and age, according to official reports. Notwithstanding preferential waterway rates secured through governmental ownership of railways in densely populated European countries, canal traffic is comparatively small. Exceptions are reported where peculiar local conditions exist, but in England inland canals are of slight use for commercial purposes.

In the United States the Inland Waterway Commission reported, page 204, that of 4,468 miles of canals built prior to 1906, 2,444 miles, or over 50 per cent, costing \$81,171,374, had been abandoned. The proportion has increased during the past 10 years. It is probable that no two private canals in the country are making 2 per cent annually on the investment, while the only purchaser for bankrupt canals to-day is to be found at the United States Treasury.

Continuation of lake deep waterways like the Soo Canal will not be confused with the antiquated class of canals which, like the ox cart, have been superseded by modern transportation methods. The latter constitute a glaring source of waste. For illustration, although our Government has spent \$4,555,000 for navigation on the 26-mile Muscle Shoals Canal, two freight trains could easily have hauled all the commerce passing through the locks in 1913. More startling, an initial item for another appropriation of \$10,375,000 for navigation on this same 26-mile canal was contained in the 1915 bill. Twice stricken from that bill, it is to be inserted later in the 1916 bill—a possibility under present legislative methods. The only significant traffic carried by canals to-day appears to be in the form of Government appropriations.

No detailed attempt will here be made to present many waterways which have been criticized on the floor of the House and Senate during the discussion of the two river and harbor bills defeated last session. A few questionable projects have been presented, on which over \$275,000,000 has been expended and on which, according to present plans, as much more will be spent during the next 10 or 15 years. The minority contends that by far the greater part of the money expended has been without benefit to commerce or navigation and that proposed future expenditures offer less promise. Time-honored waterway joke projects that ever remain the subject of ridicule have been practically omitted from this report, because enough has been here offered to disclose enormous waste.

ALL WATERWAY BILLS ARE ALIKE WASTEFUL.

No detailed reports of amounts awarded by the committee by the pending bill need be offered beyond the bare statement that the 1917 bill is as bad as its predecessors. This necessarily occurs where engineers' recommendations and omnibus measures are the sole limit of legislative responsibility. Again I quote from Report 254:

WHERE THE MONEY GOES.

In order to present the destination of waterway appropriations in concrete form, it may be stated that two substitute bills reaching \$20,000,000 and \$30,000,000 were passed during the Sixty-third Congress in lieu of two bills aggregating \$92,000,000, which were defeated.

The \$50,000,000 was by law turned over to Army engineers for allotment, and out of 240 projects given specific amounts the following was awarded to an even dozen waterway projects:

Engineers' allotment, 1914 and 1915, of \$47,586,000, and 1916 bills.

Rivers.	1914, twenty million.	1915, thirty million.	Total, Sixty-fourth Congress.	1916, proposed bill, \$39,608,410.
Mississippi.....	\$5,250,000	\$5,815,000	\$11,065,000	\$8,320,000
Missouri.....	950,000	1,109,000	2,050,000	1,750,000
Ohio ¹	1,769,000	3,915,000	5,684,000	5,509,000
Tennessee.....	223,000	501,000	724,000	944,000
Cumberland.....	210,000	378,000	588,000	710,000
Ouichita.....	300,000	136,000	436,000	499,000
Aransas Pass.....	470,000	180,000	650,000	100,000
Sabine Pass.....	240,000	100,000	340,000	590,000
Brazos.....	230,000	240,000	470,000	390,000
Black Warrior.....	768,000	48,000	816,000	.....
Cape Fear.....	185,000	323,000	508,000	218,500
Beaufort Canal.....	.....	400,000	400,000	1,000,000
Total.....	10,595,000	13,136,000	23,731,000	20,030,500

¹ The Ohio River was also given \$3,200,000 in the 1915 sundry civil bill.

Of two hundred and twenty-odd projects given the remaining 50 per cent from the 1914 and 1915 allotments, about one-half were trafficless rivers, which have a combined actual commerce less than the waterway tonnage of Buffalo or Boston or Cleveland or Philadelphia, or several other lake and ocean harbors. The 12 rivers that received \$23,731,000 in 1914 and 1915, or 50 per cent of the total during the Sixty-third Congress, are well recognized by the committee in the 1916 bill with an aggregate of \$20,030,500 out of \$39,358,410 contained in the bill after deducting \$250,000 for surveys.

The 1916 bill, from which the minority dissents, gives these same 12 river projects nearly as much as was allotted for the two years 1914 and 1915. More striking, one-half of the entire proposed 1916 appropriation goes to these 12 river projects. Deducting \$20,030,500 above provided and \$250,000 for new surveys leaves \$19,327,910, which is divided among the remaining 270 items. Of these items approximately 170 are canals, bayous, and rivers, all of which do not handle as much actual commerce as two or three harbors that can be named.

Over \$250,000,000 has been spent on the 12 river and canal projects by the Government in an effort to resuscitate a lost commerce. Deducting floatable timber and sand that floated a half century ago in larger quantities than to-day and do not require expensive waterways, several of these projects are reported to have floated in 1913 approximately as follows:

	Tons.		Tons.
Upper Mississippi ¹	170,000	Beaufort Canal.....	65,000
Lower Mississippi.....	200,000	Cumberland.....	53,000
Ohio (95 per cent coal) under.	2,000,000	Missouri.....	24,000
Tennessee ²	200,000	Hennepin Canal.....	11,850
Tombigbee and Warrior, ³ average.....	56,000	Muscle Shoals Canal.....	5,887
		Red River.....	1,694

¹ Average upper Mississippi haul less than 50 miles, or less than 39,000 tons average continuous haul.
² Includes on Tennessee 78,000 tons coal hauled 16 miles.
³ Includes on Warrior 32,000 tons coal, distance not stated.

Aside from soft coal, as near as can be estimated, the average haul was from 30 to 100 miles on the various rivers.

During 1914, 1915, and 1916 approximately one-half of the entire amount given to all waterways was for these 10 river and canal projects. The balance was divided among about 270 or more projects, of which 20 genuine waterways disclosed 1913 traffic as follows:

10 ocean harbors.	Tons.	10 lake harbors.	Tons.
New York (estimated).....	160,000,000	Superior-Duluth.....	46,875,000
Philadelphia.....	28,267,335	Chicago-Calumet.....	13,275,000
Boston (estimated).....	20,000,000	Milwaukee.....	8,647,000
Baltimore.....	11,781,942	Ashland.....	5,623,309
Norfolk.....	17,349,942	Ashtabula.....	15,743,375
Savannah.....	3,154,089	Cleveland.....	16,488,083
New Orleans.....	6,442,932	Buffalo.....	18,920,854
Galveston.....	4,445,088	Erie.....	3,340,071
San Francisco.....	9,353,530	Marquette.....	1,852,229
Portland, Oreg.....	7,923,902	Soo Canal.....	79,714,344

Approximately 200,000,000 tons of waterway commerce was handled at the 10 ocean ports, and, allowing for duplications, one-half that amount at the 10 lake ports. Presumably the commerce was carried on the average 200 to 500 miles, counting ocean and lake traffic, but like some other waterway statistics no definite figures are available.

The significance of the comparisons will not be overlooked. Ten ocean ports handled fifty times the actual commerce carried on 10 river projects that annually receive about half of the average waterway bill, and these same rivers floated only about 4 per cent of the commerce counted at 10 lake ports.

If further authority is desired for the charge of extravagance and waste lodged against the present system of recommendations and appropriations, attention is invited to a full reading of report 254, last referred to.

The pending bill should be defeated. It is overburdened with wasteful appropriations that should be disallowed or materially reduced. Legitimate navigation needs must be cared for, but we have drifted far from the policy of our legislative ancestors and have thrown chart and compass to the winds. Only a reorganization of the Government's waterway policy and a repudiation of present methods will afford permanent relief.

WATERWAY LOBBYS DESIRE OMNIBUS BILLS.

A waterway "congress" met in Washington this year coincident to the reassembling of the National Congress. Permanent quarters are occupied by this organization in the city of Washington the year round and a publicity bureau is constantly engaged in giving legislative advice to Members of Congress and in starting local pressure familiarly known as "backfires" against those who oppose wasteful waterway bills. Abundant evidence of its mission and methods was placed in the Record during the Sixty-third Congress by both Senators and Representatives.

A high official of this administration, who has presided in three debates against waterway omnibus bills in another legislative body, was called upon to welcome the "congress" this year. Instead of perfunctory words of welcome this official frankly criticized present legislative methods, urging a coordination of rail and river traffic by putting both under the same control; and he further proposed that Congress enlarge the powers of the Interstate Commerce Commission to cover that added jurisdiction. Surely that judgment is based on good grounds.

A publication issued by another waterway organization says in a recent issue gratuitously placed on the desk of Members within the last few days:

The Chief of Engineers has recommended the immediate acquisition and modernization of the — Canal. His action is based on the needs of interstate commerce. * * * Therefore, write now to your Congressman. Tell him now is the time to take on the — Canal (eventually a \$20,000,000 project). Tell him the business interests of the East have been patient but there is a limit to patience. Tell him that from every standpoint there is no project now in the bill that has greater merit than this. (Advance knowledge of the bill's contents apparently was possessed early in December, although the bill was not reported for a month thereafter.) Ask him to confer with his friends on the River and Harbor Committee and definitely to request their support for the — item, when the schedules are made up. Do it now. This means every member and friend of this association. It means you.

PRESSURE URGED ON EVERY PROJECT.

Similar pressure was exerted last session through several State resolutions which demanded the immediate improvement by the Government at \$18,700,000 expense of the Muscle Shoals 150-foot lock-and-dam project for "navigation" and incidental water power on the Tennessee River. This project also was recommended by the Chief of Engineers who in like manner recommended the lower Missouri \$20,000,000 project, that incidentally reclaims 500,000 acres of private lands.

A portion of the press which opposed wasteful river and harbor legislation is frequently lectured by Members having projects in waterway bills. "Giving out sensational statements to all the people that because of a 'pork barrel' a rivers and harbors bill should not pass." This sentiment expressed before a waterway organization was accompanied by a threat that important appropriations for New York Harbor would be "cut out" if the publications maintained their fight against such bills.

Fortunately the press of the country as a rule refuses to be muzzled by such threats. A simple method of removing the question from waterway lobby pressure on the one hand and an aroused public protest against waste on the other, will be reached by refusing to pass omnibus bills and by giving a responsible administrative body jurisdiction to investigate waterway improvements, which have thus far cost the Government nearly \$900,000,000 without any commensurate return for this enormous expenditure.

LUMP-SUM APPROPRIATIONS.

An omnibus waterway bill is constructed without any consideration for pressing commercial needs, and is based on other influences that would not be proper to discuss in this report. A defeat of the pending bill is imperative apart from its self-evident extravagance, if we are to attempt a logical businesslike way of handling waterway improvements. A temporary emergency fund of ten or fifteen million dollars ought to be placed in the hands of some responsible agency to administer according to the most pressing needs of the country as a whole. Bitter protests have been registered against intrusting such funds to the hands of the Secretary of War, who turns the matter over to the Chief of Engineers.

ENGINEERS' DEFENDERS WHO DISTRUST ENGINEERS.

Those who quote the engineers in defense of individual projects, vigorously reject their authority and judgment when called upon to spend lump-sum appropriations. After examining the engineer's allotment of a \$20,000,000 fund in 1914 and a \$30,000,000 fund in 1915, which gave practically one-half of each fund to a dozen questionable river projects as is shown elsewhere in this report, no justification can be offered for those allotments. It is needless to say we have been committed to hundreds of wasteful projects, which are poor or useless investments. No business man, State, or lesser municipality would continue a self-evident waterway failure. It remains for our official advisers, who have plunged us into this saturnalia of extravagance, blindly and autocratically to demand and dispense funds for the support of a hoard of employees all over the country maintained at Government expense, irrespective of the Government's actual commercial needs. Providing Col. Townsend and Col. Deakyne could prevail upon the Secretary of War to ignore the demands of wasteful projects, then some chance for improvement would be afforded. The 1914 bill provided that engineers should reexamine certain wasteful projects, specifically named, and gave authority to reexamine all projects with a view to dropping those that were of no value. That authority was not exercised excepting in one or two cases with recommendations for abandonment and in those cases Congress generally overrode the engineer's effort to abandon projects as they were directed to do by that same Congress.

Under the present system, or lack of system, it is like jumping out of the frying pan into the fire to turn over to Army engineers a fund for allotment. In view of their past recommendations and past allotments, however, unless a temporary commission composed of members of the Cabinet, the Interstate Commerce Commission, or some other emergency proposal can be agreed upon, it is submitted that the only alternative is again to leave the matter in the hands of the Secretary of War. One more allotment like that of 1914 or 1915 ought to persuade Congress to abandon the present system of unlimited control by Army engineers, but no projects can be stricken from the omnibus bill due to its character, so cutting down the total appropriation seems to be the only course to pursue. Waste and extravagance can be lessened by reducing the total appropriation, but the proportionate waste, judging from past experience, will be as large as heretofore.

AN INVESTIGATING COMMISSION AUTHORIZED BY THE PENDING BILL.

The pending river and harbor bill carries a proposal for a commission to be composed of four Cabinet officers and to include the chairmen of the River and Harbor Committee of the House and the Commerce Committee of the Senate, with such other appointees as may run the gauntlet of both Houses. This commission is to investigate and recommend to Congress some system for coordinating river and harbor improvements, flood control, land reclamation, irrigation, etc.

Briefly, such committee will give little helpful information to Congress and for obvious reasons its appointment could only serve to give some certificate of character to present appropriation methods which are generally acknowledged to be bad and objectionable.

The political personnel of such a commission speaks for itself. It represents the wishes and policy of the administration alone, and, in view of four years' experience with these various measures, would give little confidence in its findings. The Secretary of War, under the advice of the Chief of Engineers, aided by the chairmen of two committees who have supported the present waterway system, may be depended upon to offer no new suggestions of value in uprooting an objectionable system of river and harbor distribution which they have always defended and excused. The flood-control system adopted by the House and just starting out with unlimited possibilities for draining the Public Treasury for the benefit of private-land interests, would undoubtedly be influenced in that commission by the same interests that have developed the new liberal method of squandering public funds.

Without further discussion, it is respectfully submitted that the whole proposal promises a blanket scheme of expenditures which in amount and character will rival the present objectionable lack of system without reaching any businesslike conclusions, because none of the members of the Cabinet are able to give personal attention to the work, nor are they experienced in any of the lines of investigation proposed. Their work would be turned over to subordinates, and any report made by such a commission would be based upon the opinions of such subordinates and upon data taken from the various offices which would add little to the fund of information now possessed by Congress.

The only kind of board or commission that will give needed, well-considered plans for the coordination of these activities and place the Government on a business basis, would be one selected from high-class business men, employed exclusively to study conditions, be aided by the services of experts familiar with conditions in other countries as well as our own. Such a board may be able to present a businesslike budget system or a constructive plan in lieu of the present haphazard lack of system. However, the Interstate Commerce Commission and the Trades Commission have been able to give intelligent consideration of specific lines of work largely because the service of such commissions has been confined to a limited field. Any board or commission that copes with a comprehensive consideration of the navigation interests of the Government, or of its reclamation work, will find its time and energies fully employed. This fact is emphasized by the proposed necessary duties provided in House bill No. 6821, which provides for an effective waterway board having the same relative jurisdiction as that now conferred by Congress on the Interstate Commerce Commission for the regulation of railways.

LEGISLATIVE METHODS.

While expressing appreciation of the ability and high character of colleagues on the committee and of the kindness invariably extended by its able chairman, the minority expresses the belief that the present system of preparing waterway bills and determining the several items of appropriation is inherently open to criticism. During last session high authority stated to the House that those who ask for assignment on the committee are ordinarily deeply interested in

some local project or projects. To the same effect a Member tried to circumstantially demonstrate on January 19, last session, that committee members representing 16 States secured for their States and for the Mississippi River approximately 80 per cent of the last bill, which reached \$34,138,580.

Whether these claims were true or a mistake is not important, as under the present system of legislation Members are reasonably expected to be interested in projects scattered throughout the country, because their colleagues urge many proposed improvements in which they are deeply interested. No better evidence of interest can be afforded than the presence of strong delegations gathered from both ends of the Capitol pressing upon the committee the merits of some particular project. Possibly this method leads to waterway efficiency, but with countless influences to withstand it is submitted that more satisfactory and efficient results ought ordinarily to be secured for waterways by transferring duties now performed by a committee, however able and high-minded, to a high-class, disinterested board similar to those serving in the different European countries. Sitting continuously, uninfluenced by personal considerations, thoroughly investigating every project, it is submitted such board could better determine the merits and needs of different projects that now clamor for recognition during every session.

A REMEDY PROPOSED TO REDUCE WASTE AND INCREASE WATERWAY EFFICIENCY.

The minority represents that the present waterway policy is wasteful, extravagant, and without definite purpose. That probably one-half of present waterway appropriations are wasted. That engineers are largely responsible, while approvals or rejections are repeatedly broken down so as to make their action of little or no value as a protection against waste. That burdens of waterway extravagance due to maintenance will rapidly increase under present conditions. That no relief is practicable without adopting some comprehensive administrative scheme based on European methods and efficiency.

Therefore the minority recommends the adoption of H. R. 6821, a bill creating a national waterway commission and providing—

That a high-class, nonpolitical board be appointed by the President, with directions to carefully investigate the present status of Government waterways and to provide an intelligent scheme of waterway development;

That said board's investigation further be directed toward destructive railway competition and plans be recommended for securing railway-minimum tariff legislation, providing it be found practicable in promoting waterway commerce;

That the board be further empowered to construct experimental river craft;

That the board be given exclusive authority over waterways, with power to recommend appropriations therefor to the appropriations committee, which latter committee shall include the proposals in whole or in part in a budget bill for congressional action.

For more definite particulars reference is had to bill No. 6821, attached hereto.

PROPOSED SUBSTITUTE BILL FOR 1916.

Pending the adoption of such bill or other change in methods, the minority recommends a tentative substitute in lieu of the bill reported by the majority and that substantially the following be adopted:

There is hereby appropriated, out of any money in the United States Treasury, for the maintenance and improvement of rivers and harbors, \$15,000,000, to be expended by the Secretary of War as follows: Not to exceed \$5,000,000, shall be set apart for the maintenance and improvement of the rivers and waterways of the Mississippi Valley; and in the expenditure of such fund provision shall first be made for open-channel work and the necessities of existing river and inland waterway navigation. Ten million dollars and such additional balances as may be available shall be expended for the maintenance and improvement of harbors and other remaining waterways of the country. In the allotment of such funds, provision shall first be made for maintenance and urgent commercial needs of such harbors and waterways. Not exceeding \$50,000 shall be used for new surveys, and no allotment other than for necessary maintenance shall be made for any project heretofore recommended by Army engineers for abandonment or for modified improvement. And the engineers shall present to the next Congress at the beginning thereof a complete report of all expenditures, with such further recommendations for abandonment of projects or modification as by them may be determined for the public good.

The minority states, in conclusion, that the above amount of \$15,000,000 is recommended because of the present condition of the Treasury, and from a disclosure that of \$50,000,000 allotted by Army engineers under the two separate bills for two years, passed by the Sixty-third Congress, one-half of that amount might have been saved without interfering with legitimate needs of any existing waterway commerce.

JAMES A. FREAR.

EXHIBIT.

A BILL (H. R. 6821) Creating a national waterway commission.

Be it enacted, etc., That a commission is hereby created and established, to be known as the national waterway commission, hereafter referred to as the commission, which shall be composed of five commissioners, who shall be appointed by the President, by and with the advice and consent of the Senate. Not more than three of the commissioners shall be members of the same political party. The first commissioners appointed, shall continue in office for terms of three, four, five, six, and seven years, respectively, from the date of the taking effect of this act, the term of each to be designated by the President, but their successors shall be appointed for terms of seven years, except that any person chosen to fill a vacancy shall be appointed only for the unexpired term of the commissioner whom he shall succeed. The commission shall choose a chairman from its own membership. No commissioner shall engage in any other business, vocation, or employment. Any commissioner may be removed by the President for inefficiency, neglect of duty, or malfeasance in office. A vacancy in the commission shall not impair the right of the remaining commissioners to exercise all the powers of the commission.

SEC. 2. That each commissioner shall receive an annual salary of \$10,000, payable in the same manner as the judges of the courts of the United States. The commission shall appoint a secretary, who shall receive an annual salary of \$5,000, payable in like manner. The commission shall have the authority to employ and fix the compensation of civil engineers, clerks, and other employees as it may from time to time find necessary for the proper performance of its duties and as may be from time to time appropriated by Congress, and in making appointments for continuous service the commission, so far as practicable, shall select its employees from the classified service.

All property of the United States in the hands or under the control of Army engineers or other officials or of private individuals or public contractors, including dredges, steamboats, barges, yards, and other property used in the improvement of public waterways, shall be placed under the jurisdiction and authority of the commission.

SEC. 3. That the Secretary of War may, if practicable, detail such Army engineers as are requested by the commission to assist in organizing and establishing a comprehensive system of waterway improvement, providing that such details of engineers shall not be made to the detriment of their military duties.

SEC. 4. That the commission shall have the authority and it shall be its duty to make an investigation of all waterway projects now constructed in whole or in part by Federal aid. The commission shall prepare a complete and succinct statement, by years, of the amount heretofore appropriated for each project, the estimated amount required to complete such project, a report of the commerce now served and to be served, the character of such commerce given by separate items so far as can be furnished, the source of information, the interests to be served, the kind of water craft used, and such other information as may be useful in determining the public use and value of the project. The commission shall also furnish Congress, at the earliest practicable date, information concerning all harbors and waterways now improved or being improved in whole or in part by Government aid, showing the amount of commerce, character of terminals or landings, ownership thereof, and, so far as practicable, ownership of regular lines of craft used thereon; and the commission shall also report its recommendations for the finishing of the projects now being constructed or modification of existing plans or abandonment of work on any project, together with findings upon which such recommendations are based.

The commission shall further ascertain and report what projects are now being improved for purposes other than navigation, and if for power development, a full statement of interests concerned, officers and stockholders, public use to be served, if any, private or public contribution toward expense of construction, and the commission's recommendations thereon. Said commission shall further ascertain and report what projects are now being carried on in whole or in part for land-reclamation purposes, the character of such project, amount of lands to be recovered, estimated value of such lands, ownership thereof, and contributions now being made by beneficiaries toward such expenditures, together with the commission's recommendations.

The commission shall make a full investigation into all work now being performed by the Mississippi River Commission, the amount of money heretofore expended on such river, character and permanency of work performed, and reclamation interests now being served, if there be any, a full statement of contributions by public or private interests toward said work, together with a comprehensive and intelligible report of the probable cost of the present plans of levee construction or other river improvement now being undertaken, the percentage of project completed, and this commission's recommendation thereon. Such Mississippi River report shall be separate and distinct from reports on other projects now under improvement by the Federal Government.

All of such data and all other available information of a pertinent character affecting particular projects or entire waterway improvements now being conducted by the Federal Government shall be collected in convenient form and presented to Congress in installments at the earliest practicable date.

When the commission shall have reason to believe at any time that the proposed project is not for general use of the public or will not warrant further expenditures, or if contributions shall be required to be furnished before further appropriations are made or further expenditures authorized, such commission shall immediately report to Congress, with a preliminary recommendation thereon, and shall furnish a copy thereof to the United States Treasurer. That thereupon, when so recommended, the Treasurer shall withhold all funds theretofore appropriated not specifically obligated under existing contracts and shall refuse further payments until subsequent and specific action shall be had thereon by Congress.

SEC. 5. That prior to the presentation of any new waterway project appropriations the commission shall cause a careful survey of the proposed improvement, and if it shall appear such project is to serve a public use and is feasible, the commission shall thereupon collate data showing the estimated cost thereof, commerce to be served, water craft to be used, public terminals furnished, and contributions recommended to be made by public or private interests, together with such additional data as has heretofore been specifically required to be furnished on existing projects. The commission shall thereupon transmit to the Committee on Appropriations of the House of Representatives a full report concerning such new project or projects, its recommendations thereon, and, if requested so to do, all other and further information that may be required by the Committee on Appropriations.

Whenever the commission shall determine that any waterway project is primarily for power or land-reclamation purposes or to serve special interests, the commission may recommend Government aid for such project, notwithstanding the special interests to be served, and shall prepare data showing the proportionate amount of Federal aid recommended, together with suitable restrictions as to audit and payment of funds from the Public Treasury. Such recommendation shall be presented as a proposed separate bill to the Committee on Appropriations of the House and shall not be embodied in any general waterway appropriation bill by such committee.

Whenever any new survey shall be proposed for any waterway project, the commission, prior to such survey, may require data to be furnished showing the public use and prospective commerce to be served and such other information as may be desired, and a brief synopsis of such information shall be furnished to Congress by the commission to accompany any recommendations made for new surveys.

All existing waterways, new projects, and new surveys shall be classified, so far as practicable, prior to each regular session of Congress, together with estimates of appropriations required for maintenance and improvement for the ensuing two-year period, and a brief report as to each project considered shall be separately prepared and, with the commission's recommendation thereon, shall be placed in the hands of the Committee on Appropriations of the House at the beginning of each session.

Whenever the Appropriations Committee so requires, the commission shall furnish additional data concerning any project, and shall further aid the Committee on Appropriations when requested so to do in the preparation of the regular river and harbor bill, which shall be prepared and presented by the Committee on Appropriations of the House.

The commission shall further compile and cause to be published at the earliest practicable date for the use of Congress an intelligent, concise statement of past waterway expenditures by the Government and of amounts needed to complete all continuing projects, and shall further give estimates of future obligations to be incurred by new projects recommended for construction. The commission shall give preference in its recommendations to Congress of appropriations needed to complete the more important projects, and, so far as practicable, shall enter upon a program looking toward the early completion of such projects.

The commission shall make a thorough investigation of reasons for loss of river traffic and shall make recommendations for the reestablishment of such traffic. It shall ascertain and determine the most available craft for river use, and, as soon as practicable, shall prepare plans and build experimental craft for such purpose.

Whenever reason therefor shall appear the commission may fix reasonable freight rates on all interstate water-borne traffic by common carrier and upon all such traffic on navigable waters wholly within the State, subject, however, to the jurisdiction now conferred by law on the Interstate Commerce Commission to fix maximum joint rates between and over rail and water lines.

The commission shall determine the reasonableness of wharfage or water-terminal charges, whether such terminals are owned by private persons or municipalities, and all river and harbor improvements, including terminal facilities, shall be under the supervision and control of the commission.

Whenever the commission shall determine that unprofitable railway freight tariffs are maintained in any given case in order to prevent waterway competition, it shall be the duty of the commission to make a report thereon in duplicate to the Interstate Commerce Commission and to Congress, with recommendations that Congress give power, if need be, to the Interstate Commerce Commission for fixing minimum railway rates.

The commission shall at the earliest practicable date adopt an intelligent system of national waterway improvement and shall perform such other and further duties as may present themselves from time to time.

Whenever it shall be desirable to secure sworn testimony from any witness or witnesses relating to any project or to navigation generally, or whenever the commission shall have reason to believe that private interests are secretly or improperly seeking to influence the commission or to force the passage of any private or public waterway measure through Congress the commission may cause a hearing or summary investigation to be held, and for that purpose may issue summons, subpoenas, or other writs in the same manner and under the same procedure as is more specifically set forth in the act to regulate commerce approved February 4, 1887, and the amendments thereto, which portions of such act relating to procedure, so far as applicable, are made a part of this act, and may bring before such commission all parties believed to be informed concerning the facts or interested in the passage of such measure. A complete record shall be preserved of the testimony taken at such hearing and a certified transcript thereof shall be transmitted immediately to the Committee on Appropriations.

SEC. 6. That all unexpended balances to the credit of any project not specifically obligated under existing contracts shall, from the date of the passage of this act, be transferred by the Treasurer to the general fund, and all vouchers thereafter paid by the Treasurer shall be upon order of the national waterway commission.

SEC. 7. That the sum of \$500,000, or so much thereof as may be necessary, be, and the same hereby is, appropriated, out of any money in the Treasury, to carry out the provisions of this act.

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